

September 8, 2021

Edward H. Chu  
Acting Regional Administrator  
U.S. EPA, Region VII  
11201 Renner Boulevard  
Lenexa, KS 66219

Dear Edward Chu:

The Missouri Department of Natural Resources' Air Pollution Control Program (Air Program) hereby submits the following State Implementation Plan (SIP) revision for your approval:

*Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard*

Through this submission, the Air Program is requesting that EPA take the following actions:

- Approve Missouri's SIP as meeting the marginal area plan submission requirements of Clean Air Act 182(a) for the St. Louis nonattainment area under the 2015 ozone standard including a complete 2017 inventory of ozone-precursor emissions.

The Missouri Air Conservation Commission adopted this SIP at the August 26, 2021 commission meeting. The commission has full legal authority to develop a SIP pursuant to Section 643.050 of the Missouri Air Conservation Law. The Air Program held a public hearing for the SIP on May 27, 2021. The Air Program accepted comments on the SIP from April 26, 2021 through June 3, 2021. During the public comment period, the Air Program received three (3) comments from the U.S. Environmental Protection Agency (EPA). A summary of the comments received and our responses is attached.

The Air Program is providing a searchable pdf version of this document through EPA's State Planning Electronic Collaboration System (SPECS) and the Air Program will post the complete submittal package on our website.

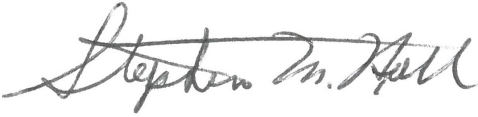


Edward H. Chu  
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Thank you for your attention to this matter. If you have any questions regarding this submittal, please contact Ms. Emily Wilbur with the Missouri Department of Natural Resources' Air Pollution Control Program at P.O. Box 176, Jefferson City, MO 65102 or by telephone at (573) 751-4817.

Sincerely,

AIR POLLUTION CONTROL PROGRAM

A handwritten signature in dark ink, appearing to read "Stephen M. Hall". The signature is fluid and cursive, with a horizontal line crossing through the middle of the name.

Stephen M. Hall  
Director

SMH:abc

Enclosures:

Copy of plan (and appendices)  
Copy of signature pages certifying MACC adoption  
Copy of public hearing notices  
Copy of public hearing transcript introductory statement  
Copy of recommendation for adoption  
Copy of the summary of comments and responses

c: Missouri Air Conservation Commission  
File# 2015-O3-3 Nonattainment

# **Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard**

**Prepared for the  
Missouri Air Conservation Commission**



**Adoption  
August, 26, 2021**

**Missouri Department of Natural Resources  
Division of Environmental Quality  
Air Pollution Control Program  
Jefferson City, Missouri**

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## Executive Summary

The purpose of this document is to address the Clean Air Act requirements for the Missouri portion of the St. Louis nonattainment area under the 2015 ozone standard. The Missouri Department of Natural Resources' Air Pollution Control Program (air program) has prepared this state implementation plan (SIP) in accordance with the U.S. Environmental Protection Agency (EPA) SIP requirements rule for the 2015 ozone standard.<sup>1</sup> This plan addresses all required elements for marginal area plans, including a comprehensive base year emissions inventory for nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC) in the area.

The Missouri portion of the St. Louis nonattainment area includes St. Louis City, St. Charles, Jefferson, and St. Louis counties, and Boles Township in Franklin County (hereafter, referred to as the St. Louis nonattainment area). The St. Louis nonattainment area is classified as a marginal ozone nonattainment area. Clean Air Act Section 182(a) includes the required SIP submissions for marginal ozone nonattainment areas. The main element addressed in this plan is the submission of a comprehensive, accurate, current inventory of actual emissions from all sources in the area.

Other Clean Air Act elements for marginal areas include nonattainment new source review (NNSR) permitting requirements, the emissions statement requirement, and the general offset requirement. The air program has already addressed these other elements through previous plan submissions. However, this document includes explanations of how the air program has addressed these other elements for the St. Louis nonattainment area.

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<sup>1</sup> 83 FR 62998, Federal Register Volume 83, Issue 234 (December 6, 2018)

# 1. Background

On October 26, 2015, EPA finalized a revised standard for the criteria pollutant ground-level ozone.<sup>2</sup> The revision strengthened the primary and secondary standards, decreasing them from 0.075 parts per million (ppm) to 0.070 ppm, based on the three-year average of the annual fourth-highest eight-hour daily maximum concentrations. This revised ozone standard became effective on December 28, 2015.

When EPA revises a standard for a criteria pollutant, the Clean Air Act requires states to review air quality monitoring data and submit boundary designation recommendations. On September 30, 2016, the air program submitted its original boundary recommendation for the 2015 ozone standard to EPA. The original recommendations were based on the ozone air quality monitoring data for the three years of 2013-2015. Then, in February 2018, the air program updated the boundary recommendations based on air quality data for the three years of 2015-2017.

In a letter to the Governor of Missouri, dated April 30, 2018, EPA outlined their final decision for boundary designations in Missouri under the 2015 ozone standard. EPA designated the City of St. Louis, the counties of St. Louis and St. Charles, and Boles Township in Franklin County as nonattainment and all other areas of the state as attainment/unclassifiable. EPA published these final designations in the Federal Register on June 4, 2018 with an effective date of August 3, 2018.<sup>3</sup> In this initial designation action, EPA designated Jefferson County as attainment for the 2015 ozone standard. However, on June 14, 2021, in response to a D.C. Circuit Court of Appeals remand of the initial designations for several counties across the country, EPA revised the initial designation for Jefferson County to nonattainment. In this action, EPA added Jefferson County to the St. Louis marginal nonattainment area for the 2015 ozone standard with an effective date of July 14, 2021.<sup>4</sup>

Attainment dates and SIP submission requirements are dependent upon area classification designations. Under section 182(a) of the Clean Air Act, marginal areas have up to 3 years from designation to attain the standard. States are not required to submit an attainment demonstration for marginal areas. The attainment deadline for marginal nonattainment areas is August 3, 2021 to attain the 2015 ozone standard, unless EPA grants a 1-year exemption pursuant to Clean Air Act Section 181(a)(5).

St. Louis is a bi-state nonattainment area, and Illinois went through a similar designation process for its portion – the Metro-East side of the St. Louis area. In 2018, EPA designated Madison and St. Clair counties in Illinois as part of the bi-state St. Louis nonattainment area. However in June of 2021, EPA revised the initial attainment designation for Monroe County to nonattainment. This action added Monroe to the Illinois portion of the St. Louis nonattainment area. EPA promulgated the addition of Monroe County in the same action discussed above where they added Jefferson County to the Missouri portion of the nonattainment area. The bi-state St. Louis

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<sup>2</sup> 80 FR 65292, October, 26, 2015

<sup>3</sup> 83 FR 25776, June 4, 2018

<sup>4</sup> 86 FR 31438


nonattainment area is plotted in a map shown in Figure 1. The following is a list of the designated counties/township contained in the St. Louis Missouri-Illinois bi-state marginal nonattainment area under the 2015 ozone standard:

- St Charles County, MO
- St. Louis County, MO
- St. Louis City, MO
- Jefferson County, MO
- Boles Township, Franklin County, MO
- Madison County, IL
- St. Clair County, IL
- Monroe County, IL

**Figure 1. Map of St. Louis Bi-State Marginal Ozone Nonattainment Area**



### Legend

 2015 St. Louis Ozone NAA (Marginal)



Although not a requirement for this marginal area plan submission under CAA Section 182(a), transportation conformity applies one year after the effective date of nonattainment designations. On January 29, 2020, the East-West Gateway Council of Governments, the designated metropolitan planning organization for the greater St. Louis area, approved a transportation conformity determination for the area addressing the 2015 ozone standard.

## **2. Marginal Area Plan Requirements**

Clean Air Act Section 182(a) lists the required elements for ozone marginal area plan submissions. Within this chapter of the plan, each section below corresponds to a Clean Air Act Section 182(a) element and provides an explanation of how the air program is addressing each of these elements.

### **2.1 Emissions Inventory: Section 182(a)(1)**

Clean Air Act section 182(a)(1) requires states to submit a comprehensive base year emissions inventory for the area. Section 182(a)(1) of the Clean Air Act states that —

*Within 2 years... the State shall submit a comprehensive, accurate, current inventory of the actual emissions from all sources, as described in Section 172(c)(3), in accordance with guidance provided by the Administrator.*

For purposes of the 2015 ozone standard, EPA promulgated 40 CFR 51.1315, to clarify requirements for the base year emissions inventory. 40 CFR 51.1315(a) states that —

*...the state shall submit a base year inventory as defined by 40 CFR 51.1300(p) to meet the emissions inventory requirement of CAA section 182(a)(1)... The inventory year shall be selected consistent with the baseline year for the RFP [i.e. Reasonable Further Progress] plan as required by 40 CFR 51.1310(b).*

The definition of base year inventory per 40 CFR 51.1300(p) is:

*Base year inventory for the nonattainment area means a comprehensive, accurate, current inventory of actual emissions from sources of VOC and NO<sub>x</sub> emitted within the boundaries of the nonattainment area as required by CAA section 182(a)(1).*

The base year for RFP plans is the most recent calendar year for which a complete triennial inventory is required to be submitted to EPA under the Air Emissions Reporting Requirements rule (AERR). The most recent calendar year where a complete triennial emission inventory was required by the AERR is 2017. Therefore, states should quantify actual NO<sub>x</sub> and VOC emissions that occurred in the nonattainment area during 2017 for use in their base year emissions

inventory. As specified in 40 CFR 51.1315(c), the emission values in the base year inventory shall be ozone season day emissions, which are defined as an average day's emissions for a typical ozone season work weekday.

The air program has developed a complete ozone season day emission inventory for the year 2017 of the actual NO<sub>x</sub> and VOC emissions from sources located within the Missouri portion of the St. Louis ozone nonattainment area. The year 2017 corresponds to the most recent triennial statewide emissions inventory conducted for the National Emissions Inventory (NEI) pursuant to the federal AERR rule, which was recently updated by EPA.<sup>5</sup> This inventory conforms to EPA's latest guidance: *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations* [May 2017].

Missouri has the authority, under state regulations 10-CSR 10-6.110, to request and receive emissions data from regulated entities throughout the entire state of Missouri. At the time the 2017 emission inventory was evaluated, permitted Missouri facilities classified as Title V were required to file a complete emission inventory summary (EIS). Also, the air program manages the Missouri Emissions Inventory System (MoEIS), which is an online system for data entry and allows facilities to submit emissions data electronically to fulfill reporting requirements. MoEIS includes detailed emissions information as well as data about the egress points where pollutants were released into the air including NO<sub>x</sub> and VOCs.

The comprehensive emissions inventory the air program prepared includes point, area, and mobile anthropogenic source categories for NO<sub>x</sub> and VOCs for the 2017 base year. The inventory also includes these emissions of these pollutants from two non-anthropogenic source categories, wildfires and biogenics. Four basic steps were involved in the preparation of the emission inventory including planning, data collection, data analysis, and emission estimation and reporting. To ensure the emissions inventory is of the highest quality, the air program implemented quality assurance procedures and quality control checks throughout the inventory development process. The air program specifically followed the procedures outlined in EPA's guidance documents pertaining to inventory quality assurance, and believes the inventory is complete, accurate, and of high quality.

The ozone precursor emissions are expressed in tons per ozone season day. The 2017 ozone season day emissions inventory for the St. Louis nonattainment area is presented in Appendices A and B. Appendix A also outlines the methodology and calculations used to convert the annual emission rates from the 2017 NEI into ozone season daily emission rates. The ozone season daily emissions in Appendices A and B apply to emissions occurring during a typical weekday of the high ozone season, which is June through August. Appendix C provides 2017 nonpoint emission inventory documentation, including information on biogenic NO<sub>x</sub> and VOC emissions. Appendix D provides more detailed information on the development of the 2017 point source emissions inventory.

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<sup>5</sup> 80 FR 8787, February 19, 2015

Table 1 displays the 2017 anthropogenic emissions inventory summary for the St. Louis nonattainment area in tons per ozone season day. The anthropogenic source categories include point, area, on-road mobile, and non-road sources.

Table 2 displays the 2017 emissions inventory summary for the biogenic and wildfire (event) source categories in the St. Louis nonattainment area in tons per ozone season day. Event emissions include wild fire emissions, prescribed burning, and agricultural burning. However, when annual emissions from these three event source categories are temporally allocated to ozone season day emissions, only wild fire emissions are projected to occur during the high ozone season. Additional details regarding the development of the 2017 ozone season day biogenic and wildfire emissions inventory can be found in Appendix C.

**Table 1      2017 Anthropogenic Emissions Inventory Summary for the Missouri Portion of the Nonattainment Area (tons/ozone season day)**

of the Nonattainment Area (tons/zone season day)			
County Name	Source Category	NO <sub>x</sub>	VOC
Boles Township, Franklin County	Point Sources	21.86	1.29
Jefferson County		22.37	2.24
St. Charles County		18.94	3.71
St. Louis County		5.54	1.30
St. Louis City		3.19	2.71
Totals *		71.9	11.25
Boles Township, Franklin County	Area Sources	0.08	1.08
Jefferson County		0.47	6.99
St. Charles County		0.92	12.03
St. Louis County		2.83	39.08
St. Louis City		0.99	10.46
Totals *		5.29	69.65
Boles Township, Franklin County	Onroad Mobile Sources	1.51	0.60
Jefferson County		8.82	4.29
St. Charles County		10.70	5.02
St. Louis County		33.81	14.16
St. Louis City		9.83	4.52
Totals *		66.66	28.57
Boles Township, Franklin County	Nonroad Sources	0.64	0.25
Jefferson County		2.06	1.64
St. Charles County		5.63	3.79
St. Louis County		14.21	16.35
St. Louis City		3.78	1.86
Totals *		26.33	23.89
Grand Total *		170.18	133.36

\* Note: Figures may not total exactly due to rounding.

**Table 2      2017 Wildfire and Biogenic Emissions Inventory Summary for the Missouri Portion of the Nonattainment Area (tons/ozone season day)**

Fires

County	Type	SCC	CO	NO <sub>x</sub>	VOC
Franklin	RX	2811015001	1.17	0.01	0.27
		2811015002	5.05	0.10	1.20
	WF	2810001001	0.03	0.00	0.01
		2810001002	0.13	0.00	0.03
	<b>Total</b>		6.37	0.10	1.51
Jefferson	RX	2811015001	3.57	0.02	0.83
		2811015002	15.16	0.28	3.60
	WF	2810001001	0.06	0.00	0.01
		2810001002	0.32	0.01	0.08
	<b>Total</b>		19.11	0.31	4.52
St Charles	RX	2811015001	0.98	0.00	0.23
		2811015002	3.14	0.06	0.75
	WF	2810001001	0.01	0.00	0.00
		2810001002	0.01	0.00	0.00
	<b>Total</b>		4.14	0.07	0.98
St Louis Co	RX	2811015001	0.09	0.00	0.02
		2811015002	0.39	0.01	0.09
	<b>Total</b>		0.48	0.01	0.11
<b>Grand Total</b>			<b>30.11</b>	<b>0.48</b>	<b>7.12</b>

Biogenic \*

County	CO	NO <sub>x</sub>	VOC
Franklin Co	0.62	0.23	5.85
Jefferson	2.77	0.60	31.66
St Charles Co	1.96	0.86	12.58
St Louis	0.51	0.10	1.80
St Louis Co	2.06	0.49	12.71
<b>Total</b>	<b>7.92</b>	<b>2.29</b>	<b>64.62</b>

Note: Figures may not total exactly due to rounding.

\* Emissions from biogenic sources for year 2017 were not available at the time of writing this report. Therefore, the 2014 numbers have been used here.

## **2.2 NNSR Permitting Program: Section 182(a)(2)**

Per Clean Air Act Section 182(a)(2)(C), a marginal area plan submission shall include —

*provisions to require permits, in accordance with sections 172(c)(5) and 173, for the construction and operation of each new or modified major stationary source (with respect to ozone) to be located in the area.*

In accordance with the Clean Air Act, the air program has a long-standing and fully implemented New Source Review (NSR) permitting program for new major sources and significant modifications of existing sources enabled by state rule 10 CSR 10-6.060 *Construction Permits Required*.

In compliance with Section 182(a)(2)(C), the air program's NSR permitting program also regulates the construction of new and modified major stationary sources in nonattainment areas, such as the St. Louis ozone nonattainment area, via section (7) of 10 CSR 10-6.060. The rule defines nonattainment area pollutant in subsection (2)(J). The definition specifies that both VOCs and NO<sub>x</sub> shall be nonattainment pollutants for a source located in an area designated nonattainment for ozone. The permitting program for nonattainment areas is referred to as Nonattainment New Source Review (NNSR). The air program has been delegated full authority to implement its NSR program by the EPA.

The NSR program in any attainment area is referred to as a Prevention of Significant Deterioration (PSD) permitting program and is governed by section (8) of 10 CSR 10-6.060. The air program's PSD program is addressed in the infrastructure SIP for the 2015 ozone standard, which can be accessed by the public on the air program's website.

Some features of the air program's NNSR program that differ from the air program's PSD program for new major sources and major modifications at existing sources include —

1. lower emission thresholds for determining applicability,
2. the implementation of lowest achievable emission rate,
3. alternate site analysis, and
4. emission offset reductions (offsets).

## **2.3 Source Emission Statement: Section 182(a)(3)**

Clean Air Act Section 182(a)(3)(A) requires states with marginal nonattainment areas to submit periodic emissions inventories similar to the base year emissions inventory discussed in section 2.1 of this document. States must submit these periodic inventories at least as often as every three years until the area is redesignated to attainment.

Clean Air Act Section 182(a)(3)(B) requires states with marginal nonattainment areas to submit an emissions statement SIP.<sup>6</sup> This emissions statement SIP outlines how certain facilities must report emissions and facility activity data to air agencies. Reports submitted to air agencies must be accompanied by “*a certification that the information contained*” in the report is “*accurate to the best knowledge*” of the facility.<sup>7</sup> To properly implement the emissions reporting requirements, state regulations addressing the emissions statement SIP requirements should be coordinated carefully with the data elements that EPA requires.<sup>8</sup>

Clean Air Act Section 182(a)(3)(B) also requires the SIP to contain requirements for certain sources of NO<sub>x</sub> and VOCs to report their actual emissions of these ozone precursors every year in an emissions statement for the purpose of developing current, comprehensive and accurate emission inventories.

The air program is committed to providing future emissions inventory updates at least every three years to enable tracking of ozone-precursor emissions levels in the St. Louis nonattainment area. State Regulation 10 CSR 10-6.110 *Reporting Emission Data, Emission Fees, and Process Information* requires permitted sources to file an annual report on air pollutant emissions to include emissions data, process information, and annual emissions fees. These sources report their emissions on a form called an Emissions Inventory Questionnaire (EIQ) developed by the air program pursuant to 10 CSR 10-6.110. For applicable NO<sub>x</sub> and VOC sources in the St. Louis nonattainment area, the EIQs include an ozone-specific worksheet.

The methods for calculating and reporting their emissions are detailed in each source’s applicable permit. The data collected in MoEIS from the EIQs form the basis of the point source emissions inventory that is compiled on an annual basis. In addition, in compliance with the federal AERR, the air program develops a comprehensive emissions inventory of point, area, and mobile sources every three years, covering both annual and ozone season day emissions. The air program submits this emissions data to EPA for inclusion in the publicly-available NEI and uses the data for tracking progress towards attaining and maintaining the federal air quality standards, developing control and maintenance strategies, identifying sources and general emission levels, and determining compliance with emissions regulations as well as other EPA requirements. The air program also makes this data, including NO<sub>x</sub> and VOC emissions data, available to the public upon request.

## **2.4 General Offset Requirement: Section 182(a)(4)**

The fourth and final requirements for marginal area plans specified in Clean Air Act Section 182(a) is the general offset requirement. For the purposes of the NNSR permitting program, states must establish, in their marginal nonattainment area plan submission, the emission offset ratio of total VOC emission reductions to total increased VOC emissions to be at least 1.1 to 1.

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<sup>6</sup> 83 FR 62998, December 6, 2018

<sup>7</sup> “*Guidance on the Implementation of an Emission Statement Program (DRAFT)*” (July 1992) available at: <https://www.epa.gov/airemissions-inventories/implementation-emissionstatement-program>.

<sup>8</sup> Requirements listed in 40 CFR 51.1315

As mentioned in subsection 2.2.C of this document, the air program has a well-established NNSR permitting program. One of the features of NNSR is the requirement for emission offset reductions. This is codified at 10 CSR 10-6.060(7)(C)1:

*By the time the source is to commence operation, sufficient emissions offsets shall be obtained as required to ensure reasonable further progress toward attainment of the applicable national ambient air quality standard and consistent with the requirements of paragraphs 40 CFR 51.165(a)(3) and (9);*

The requirements for determining credits for emission offset purposes are codified at 40 CFR 51.165(a)(3) per the state rule citation above. The corresponding offset ratios for each ozone area classification (e.g. 1.1:1 for marginal nonattainment areas) are codified at 40 CFR 51.165(a)(9), which is also included in the state rule the citation above. Therefore, the state rule satisfies the Clean Air Act Section 182(a)(4) requirement for marginal area plans to contain an emission offset reduction ratio of 1.1:1 as part of the state's NNSR permitting program.

### **3. Public Participation**

In accordance with Section 110(a)(2) of the CAA, the Missouri Air Conservation Commission (MACC) will hold a public hearing prior to adoption of this SIP revision and subsequent submittal to EPA. The air program notified the public and other interested parties of the public hearing and comment period at least thirty (30) days prior to the public hearing for this SIP revision. Specifically –

- Notice of availability of the proposed SIP revision and announcement of the public hearing was posted on the air program website by April 26, 2021. Any and all files, calculations, and other records associated with this SIP revision that the air program has not posted on the website are available to the public upon request.
- The MACC held a public hearing to receive comments for this proposed SIP revision on May 27, 2021.
- The air program opened a public comment period after posting the proposed SIP revision on the air program's website on April 26, 2021. The public comment period closed on June 3, 2021, seven (7) days after the public hearing.

### **4. Conclusion**

Through this plan submission, the air program has satisfied all of its marginal nonattainment area plan submission obligations for the St. Louis nonattainment area pursuant to Clean Air Act Section 182(a). Attached with this document is a complete, comprehensive, accurate, and current inventory of ozone-precursor emissions for the Missouri portion of the St. Louis nonattainment area. This plan also administratively addresses three other requirements for marginal nonattainment area plan submissions under Clean Air Act Section 182(a). The air program requests EPA to approve this plan as a revision to the Missouri State Implementation Plan.

## **Appendix A**

### **2017 Base Year Inventory Documentation**

#### Introduction

The Missouri Department of Natural Resources' Air Pollution Control Program (air program) developed a comprehensive statewide emissions inventory for 2017, as required by EPA's Air Emissions Reporting Requirements (AERR) rule, last revised in 2015 (80 FR 8787). The inventory includes point, nonpoint, nonroad mobile, and event emissions. Onroad mobile source model inputs were developed and submitted according to the AERR. This document describes how the 2017 inventory is created, including compilation and submission to the National Emissions Inventory (NEI) through EPA's Emissions Inventory System (EIS). This report documents the 2017 inventory in detail from its creation, quality assurance, and final summaries. It also details the qualifications and limitations of the inventory.

Various tables are included showing summarized, facility-specific, and source category-specific data. All emission amounts are given in tons per year unless otherwise noted. Blank fields and those with dashes indicate a value of zero. Fields with 0, 0.0, or 0.00 contain small values that round to zero.

The pollutants inventoried include the criteria air pollutants (CAPs) sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOC), coarse particulate matter (PM<sub>10</sub> Primary), fine particulate matter (PM<sub>2.5</sub> Primary), ammonia (NH<sub>3</sub>), and lead (Pb). The air program also inventories speciated Hazardous Air Pollutant (HAP) emissions for certain data categories including point sources. HAPs are only included when they meet reporting thresholds for point sources, and only for some nonpoint categories where an EPA-provided estimation tool includes those pollutants. For some data categories, particulate matter (PM) is further disaggregated to its component parts: PM<sub>10</sub> Primary is the sum of PM condensable (PM CON) and PM<sub>10</sub> Filterable (PM<sub>10</sub> FIL), and PM<sub>2.5</sub> Primary is the sum of PM condensable (PM CON) and PM<sub>2.5</sub> Filterable (PM<sub>2.5</sub> FIL). The inventory does not include greenhouse gas (GHG) emissions and none of the tables in this document summarize GHGs.

The inventory covers all 114 counties and one independent city in Missouri. There are no tribal areas in the state or local agencies that estimate emissions.

The temporal coverage of the comprehensive inventory is annual for the entire state and typical ozone season day for the St. Louis area. Annual emissions are developed for point, nonpoint, event, and nonroad mobile sources for all CAPs. Onroad mobile source model inputs are developed and submitted to EPA according to AERR requirements. Point source emissions are prepared at the facility level with a geographic coordinate. Nonpoint, onroad mobile, and

nonroad mobile sources are submitted at the county –total level. The inventory covers a continuous 12 month period from January 1 to December 31 of the year.

For the purposes of the 2015 ozone standard, the air program used the annual emission estimates and model input data to estimate emissions for the ozone precursor pollutants of CO, NO<sub>x</sub>, and VOC at the time increment of typical ozone season day. This document summarizes ozone season day emissions of the ozone precursors. This document also covers the St. Louis 2015 ozone standard nonattainment area, including:

County Name	County Code
Franklin County (only the portion in Boles Township)	29071
Jefferson County	29099
St. Charles County	29183
St. Louis County	29189
St. Louis City	29510

Where indicated, the emission estimate may be based on information from previous years where 2017 activity or emissions are not available.

Emission Totals (tons per ozone season day)

Category	CO	NO <sub>x</sub>	VOC
Point	29.87	71.90	11.25
Nonpoint	30.74	5.29	69.65
Onroad Mobile	311.75	64.66	28.57
Nonroad Mobile	421.74	26.33	23.89
Event	23.81	1.82	88.11
<b>St. Louis Nonattainment Area Total</b>	<b>817.91</b>	<b>170.00</b>	<b>221.47</b>

Detailed emission estimates, in most cases by SCC and county, are available in Appendix B.

Temporal Allocation Method

The 2017 emission inventory is created at the annual level for most emission categories. These emissions are converted from annual to ozone season day emissions using methodologies and

data sourced from the EPA. Missouri's nonattainment area inventory is created for a typical Tuesday in July, during peak ozone season, consistent with previous ozone season day inventories for the 1997 and 2008 ozone standards. The process below describes how categories with annual emissions are converted to ozone season day emissions.

## Allocation Method and Data

The Sparse Matrix Operator Kernel Emissions (SMOKE) model provides a temporal allocation methodology. The model documentation found at <https://www.cmascenter.org/smoke/>, section 6.16 describes how a temporal profile is assigned by SCC and geography, where applicable. The model then allocates annual emissions across the months of the year and days of the week. The pertinent files include the following abbreviations in their names:

- TREF: temporal cross reference file, assigns SCC to a temporal profile
- TPRO\_Monthly: monthly temporal profiles, distributes annual emissions to months
- TPRO\_Weekly: weekly temporal profiles, distributes weekly emissions to days of the week

The temporal allocation files in SMOKE are used in EPA's modeling platforms. The modeling platforms begin with a base emission inventory year, may contain projected future years, and are processed using the SMOKE model to create hourly emission estimates. The temporal allocation performed in the SMOKE model is updated with each modeling platform to account for new SCCs, updated methodologies, and revised profile assignments. The most recent EPA modeling platform at the time this inventory was developed is the 2016 Version 6.3 platform at <https://www.epa.gov/air-emissions-modeling/2016v1-platform>. Included with the files for the platform are the temporal allocation files used, including all updates and modifications. The zipped file, under "Ancillary data", is called ge\_dat\_for\_2016v1\_temporal31oct2019.zip. EPA's method and data contains sufficient data to create hourly emission estimates for all categories. For the purposes of an ozone season day inventory, only the temporal cross reference, monthly, and weekly files were needed.

The temporal cross reference tables assign each SCC to an appropriate monthly and weekly profile. For example, the St. Charles County nonpoint SCC 2401001000 for non-industrial architectural coating estimates 466.797 tons of VOC are emitted annually. That SCC is assigned the monthly profile 199, and the weekly profile 7. Monthly profile 199 allocates emissions across the months of the year as:

Monthly Profile Number	1	2	3	4	5	6	7	8	9	10	11	12
199	0.082	0.082	0.081	0.081	0.081	0.085	0.085	0.085	0.085	0.085	0.085	0.082

Weekly profile 7 allocates emissions across days of the week as:

Weekly Profile Number	1	2	3	4	5	6	7
7	0.14	0.14	0.14	0.14	0.14	0.14	0.14

To calculate ozone season day emissions for a typical Tuesday in July from St. Charles County annual emissions of 466.7973 tons:

$$\begin{aligned}
 & \text{Annual Emissions} * \text{Month 7 fraction of emissions} \\
 & \quad * \text{Fraction of monthly emissions in one week} \\
 & \quad * \text{Tuesday Day 2 fraction of weekly emissions} \Rightarrow
 \end{aligned}$$

$$\begin{aligned}
 & 466.7973 \text{ tons VOC} * 0.085 \text{ (July fraction)} * \frac{\text{month}}{4.42 \text{ weeks}} * 0.143 \text{ (Tuesday fraction)} = \\
 & \quad 1.28 \text{ tons VOC per ozone season day}
 \end{aligned}$$

This temporal allocation was performed for all nonpoint, some nonroad, and all event emission categories. Point source data is collected from regulated facilities with enough information to calculate ozone season day emission estimates specific to each facility. Onroad and nonroad model output from the Motor Vehicle Emissions Simulator (MOVES) model comes out at the temporal scale of total daily emissions. Typical weekday in July emissions are selected for these model runs.

#### 1) Point

The 2017 point source inventory is documented in Appendix D. The document describes the sources included, time period covered, data included, inventory collection and quality assurance.

Below is a summary of a portion of the point source inventory, that portion in the St. Louis nonattainment area. Typical ozone season day emissions, in tons per day, are presented.

County Name	Number of Sources	CO	NOx	VOC
Franklin (Boles Township only)	3	7.20	21.86	1.29
Jefferson County	10	7.91	22.37	2.24
St. Charles	11	2.64	18.94	3.71

County Name	Number of Sources	CO	NOx	VOC
St. Louis County	33	8.18	5.54	1.30
St. Louis City	39	3.94	3.19	2.71
<b>Area Total</b>	<b>96</b>	<b>29.87</b>	<b>71.90</b>	<b>11.25</b>

## 2) Nonpoint

Nonpoint categories include those too numerous or dispersed to inventory on an individual basis. These include residential pollution sources like home heating, painting, outdoor burning, small businesses like autobody repair shops, dry cleaners, and gas stations, and agricultural sources like livestock production and fertilizer application. Emissions from these categories are estimated using data for various industries and applying emission rates to them, then allocating those emissions to geographic areas based on population, employment, or other activity data. Many of the varied sources in the nonpoint category are estimated using tools provided by EPA using the latest methods and data available.

Details of each category emission estimates are found in Appendix C.

### 2017 Nonpoint Emission Total (tons per ozone season day)

County Name	CO	NO <sub>x</sub>	VOC
Franklin (Boles Township only)	1.05	0.08	1.08
Jefferson County	8.60	0.47	6.99
St. Charles	9.70	0.92	12.03
St. Louis	9.96	2.83	39.08
St. Louis City	1.43	0.99	10.46
<b>Area Total</b>	<b>30.74</b>	<b>5.29</b>	<b>69.65</b>

### NEI Category Description and SCCs

<b>Agriculture - Crops &amp; Livestock Dust</b>
2801000003: Miscellaneous Area Sources-Agriculture Production - Crops-Agriculture - Crops-Tilling
2805001000: Miscellaneous Area Sources-Agriculture Production - Livestock-Beef cattle - finishing operations on feedlots (drylots)-Dust Kicked-up by Hooves (use 28-05-020, -001, -002, or -003 for Waste
2805001010: Miscellaneous Area Sources-Agriculture Production - Livestock-Dairy Cattle-Dust Kicked-up by Hooves
2805001020: Miscellaneous Area Sources-Agriculture Production - Livestock-Broilers-Dust Kicked-up by Feet
2805001030: Miscellaneous Area Sources-Agriculture Production - Livestock-Layers-Dust Kicked-up by Feet
2805001040: Miscellaneous Area Sources-Agriculture Production - Livestock-Swine-Dust Kicked-up by Hooves
2805001050: Miscellaneous Area Sources-Agriculture Production - Livestock-Turkeys-Dust Kicked-up by Feet
<b>Agriculture - Fertilizer Application</b>
2801700099: Miscellaneous Area Sources-Agriculture Production - Crops-Fertilizer Application-Miscellaneous Fertilizers

<b>Agriculture - Livestock Waste</b>
2805002000: Miscellaneous Area Sources-Agriculture Production - Livestock-Beef cattle production composite-Not Elsewhere Classified
2805007100: Miscellaneous Area Sources-Agriculture Production - Livestock-Poultry production - layers with dry manure management systems-Confinement
2805009100: Miscellaneous Area Sources-Agriculture Production - Livestock-Poultry production - broilers-Confinement
2805010100: Miscellaneous Area Sources-Agriculture Production - Livestock-Poultry production - turkeys-Confinement
2805018000: Miscellaneous Area Sources-Agriculture Production - Livestock-Dairy cattle composite-Not Elsewhere Classified
2805025000: Miscellaneous Area Sources-Agriculture Production - Livestock-Swine production composite-Not Elsewhere Classified (see also 28-05-039, -047, -053)
2805035000: Miscellaneous Area Sources-Agriculture Production - Livestock-Horses and Ponies Waste Emissions-Not Elsewhere Classified
2805040000: Miscellaneous Area Sources-Agriculture Production - Livestock-Sheep and Lambs Waste Emissions-Total
2805045000: Miscellaneous Area Sources-Agriculture Production - Livestock-Goats Waste Emissions-Not Elsewhere Classified
<b>Bulk Gasoline Terminals</b>
2501050120: Storage and Transport-Petroleum and Petroleum Product Storage-Bulk Terminals: All Evaporative Losses-Gasoline
2501055120: Storage and Transport-Petroleum and Petroleum Product Storage-Bulk Plants: All Evaporative Losses-Gasoline
<b>Commercial Cooking</b>
2302002100: Industrial Processes-Food and Kindred Products: SIC 20-Commercial Cooking - Charbroiling-Conveyorized Charbroiling
2302002200: Industrial Processes-Food and Kindred Products: SIC 20-Commercial Cooking - Charbroiling-Under-fired Charbroiling
2302003000: Industrial Processes-Food and Kindred Products: SIC 20-Commercial Cooking - Frying-Deep Fat Frying
2302003100: Industrial Processes-Food and Kindred Products: SIC 20-Commercial Cooking - Frying-Flat Griddle Frying
2302003200: Industrial Processes-Food and Kindred Products: SIC 20-Commercial Cooking - Frying-Clamshell Griddle Frying
<b>Dust - Construction Dust</b>
2311010000: Industrial Processes-Construction: SIC 15 - 17-Residential-Total
2311020000: Industrial Processes-Construction: SIC 15 - 17-Industrial/Commercial/Institutional-Total
2311030000: Industrial Processes-Construction: SIC 15 - 17-Road Construction-Total
<b>Dust - Paved Road Dust</b>
2294000000: Mobile Sources-Paved Roads-All Paved Roads-Total: Fugitives
<b>Dust - Unpaved Road Dust</b>
2296000000: Mobile Sources-Unpaved Roads-All Unpaved Roads-Total: Fugitives
<b>Fires - Agricultural Field Burning</b>

2801500000: Miscellaneous Area Sources-Agriculture Production - Crops - as nonpoint-Agricultural Field Burning - whole field set on fire-Unspecified crop type and Burn Method
2801500171: Miscellaneous Area Sources-Agriculture Production - Crops - as nonpoint-Agricultural Field Burning - whole field set on fire-Fallow
<b>Fuel Comb - Comm/Institutional - Biomass</b>
2103008000: Stationary Source Fuel Combustion-Commercial/Institutional-Wood-Total: All Boiler Types
<b>Fuel Comb - Comm/Institutional - Coal</b>
2103001000: Stationary Source Fuel Combustion-Commercial/Institutional-Anthracite Coal-Total: All Boiler Types
2103002000: Stationary Source Fuel Combustion-Commercial/Institutional-Bituminous/Subbituminous Coal-Total: All Boiler Types
<b>Fuel Comb - Comm/Institutional - Natural Gas</b>
2103006000: Stationary Source Fuel Combustion-Commercial/Institutional-Natural Gas-Total: Boilers and IC Engines
<b>Fuel Comb - Comm/Institutional - Oil</b>
2103004001: Stationary Source Fuel Combustion-Commercial/Institutional-Distillate Oil-Boilers
2103004002: Stationary Source Fuel Combustion-Commercial/Institutional-Distillate Oil-IC Engines
2103005000: Stationary Source Fuel Combustion-Commercial/Institutional-Residual Oil-Total: All Boiler Types
2103011000: Stationary Source Fuel Combustion-Commercial/Institutional-Kerosene-Total: All Combustor Types
<b>Fuel Comb - Comm/Institutional - Other</b>
2103007000: Stationary Source Fuel Combustion-Commercial/Institutional-Liquified Petroleum Gas (LPG)-Total: All Combustor Types
<b>Fuel Comb - Industrial Boilers, ICEs - Biomass</b>
2102008000: Stationary Source Fuel Combustion-Industrial-Wood-Total: All Boiler Types
<b>Fuel Comb - Industrial Boilers, ICEs - Coal</b>
2102001000: Stationary Source Fuel Combustion-Industrial-Anthracite Coal-Total: All Boiler Types
2102002000: Stationary Source Fuel Combustion-Industrial-Bituminous/Subbituminous Coal-Total: All Boiler Types
<b>Fuel Comb - Industrial Boilers, ICEs - Natural Gas</b>
2102006000: Stationary Source Fuel Combustion-Industrial-Natural Gas-Total: Boilers and IC Engines
<b>Fuel Comb - Industrial Boilers, ICEs - Oil</b>
2102004001: Stationary Source Fuel Combustion-Industrial-Distillate Oil-All Boiler Types
2102004002: Stationary Source Fuel Combustion-Industrial-Distillate Oil-All IC Engine Types
2102005000: Stationary Source Fuel Combustion-Industrial-Residual Oil-Total: All Boiler Types
2102011000: Stationary Source Fuel Combustion-Industrial-Kerosene-Total: All Boiler Types
<b>Fuel Comb - Industrial Boilers, ICEs - Other</b>
2102007000: Stationary Source Fuel Combustion-Industrial-Liquified Petroleum Gas (LPG)-Total: All Boiler Types
<b>Fuel Comb - Residential - Natural Gas</b>
2104006000: Stationary Source Fuel Combustion-Residential-Natural Gas-Total: All Combustor Types
<b>Fuel Comb - Residential - Oil</b>

2104004000: Stationary Source Fuel Combustion-Residential-Distillate Oil-Total: All Combustor Types
2104011000: Stationary Source Fuel Combustion-Residential-Kerosene-Total: All Heater Types
<b>Fuel Comb - Residential - Other</b>
2104001000: Stationary Source Fuel Combustion-Residential-Anthracite Coal-Total: All Combustor Types
2104002000: Stationary Source Fuel Combustion-Residential-Bituminous/Subbituminous Coal-Total: All Combustor Types
2104007000: Stationary Source Fuel Combustion-Residential-Liquified Petroleum Gas (LPG)-Total: All Combustor Types
<b>Fuel Comb - Residential - Wood</b>
2104008100: Stationary Source Fuel Combustion-Residential-Wood-Fireplace: general
2104008210: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: fireplace inserts; non-EPA certified
2104008220: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: fireplace inserts; EPA certified; catalytic
2104008310: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: freestanding, non-EPA certified
2104008320: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: freestanding, EPA certified, non-catalytic
2104008330: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: freestanding, EPA certified, catalytic
2104008400: Stationary Source Fuel Combustion-Residential-Wood-Woodstove: pellet-fired, general (freestanding or FP insert)
2104008510: Stationary Source Fuel Combustion-Residential-Wood-Furnace: Indoor, cordwood-fired, non-EPA certified
2104008530: Stationary Source Fuel Combustion-Residential-Wood-Furnace: Indoor, pellet-fired, general
2104008610: Stationary Source Fuel Combustion-Residential-Wood-Hydronic heater: outdoor
2104008620: Stationary Source Fuel Combustion-Residential-Wood-Hydronic heater: indoor
2104008630: Stationary Source Fuel Combustion-Residential-Wood-Hydronic heater: pellet-fired
2104008700: Stationary Source Fuel Combustion-Residential-Wood-Outdoor wood burning device, NEC (fire-pits, chimeneas, etc)
2104009000: Stationary Source Fuel Combustion-Residential-Firelog-Total: All Combustor Types
<b>Gas Stations</b>
2501060051: Storage and Transport-Petroleum and Petroleum Product Storage-Gasoline Service Stations-Stage 1: Submerged Filling
2501060052: Storage and Transport-Petroleum and Petroleum Product Storage-Gasoline Service Stations-Stage 1: Splash Filling
2501060053: Storage and Transport-Petroleum and Petroleum Product Storage-Gasoline Service Stations-Stage 1: Balanced Submerged Filling
2501060201: Storage and Transport-Petroleum and Petroleum Product Storage-Gasoline Service Stations-Underground Tank: Breathing and Emptying
2501080050: Storage and Transport-Petroleum and Petroleum Product Storage-Airports : Aviation Gasoline-Stage 1: Total

2501080100: Storage and Transport-Petroleum and Petroleum Product Storage-Airports : Aviation Gasoline-Stage 2: Total
<b>Industrial Processes - Mining</b>
2325000000: Industrial Processes-Mining and Quarrying: SIC 14-All Processes-Total
<b>Industrial Processes - Oil &amp; Gas Production: 2310000551</b>
2310000551: Industrial Processes-Oil and Gas Exploration and Production-All Processes-Produced Water from CBM Wells
2310000552: Industrial Processes-Oil and Gas Exploration and Production-All Processes-Produced Water from Gas Wells
2310000553: Industrial Processes-Oil and Gas Exploration and Production-All Processes-Produced Water from Oil Wells
2310010100: Industrial Processes-Oil and Gas Exploration and Production-Crude Petroleum-Oil Well Heaters
2310010200: Industrial Processes-Oil and Gas Exploration and Production-Crude Petroleum-Oil Well Tanks - Flashing & Standing/Working/Breathing
2310010300: Industrial Processes-Oil and Gas Exploration and Production-Crude Petroleum-Oil Well Pneumatic Devices
2310011001: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Associated Gas Venting
2310011201: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Tank Truck/Railcar Loading: Crude Oil
2310011501: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Fugitives: Connectors
2310011502: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Fugitives: Flanges
2310011503: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Fugitives: Open Ended Lines
2310011505: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Fugitives: Valves
2310011600: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Production-Artificial Lift Engines
2310021010: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Storage Tanks: Condensate
2310021030: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Tank Truck/Railcar Loading: Condensate
2310021100: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Gas Well Heaters
2310021102: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
2310021202: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310021251: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Lateral Compressors 4 Cycle Lean Burn
2310021300: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Gas Well Pneumatic Devices

2310021302: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310021351: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Lateral Compressors 4 Cycle Rich Burn
2310021400: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Gas Well Dehydrators
2310021501: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Fugitives: Connectors
2310021502: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Fugitives: Flanges
2310021503: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Fugitives: Open Ended Lines
2310021505: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Fugitives: Valves
2310021506: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Fugitives: Other
2310021603: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Production-Gas Well Venting - Blowdowns
2310023000: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Dewatering Pump Engines
2310023010: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Storage Tanks: Condensate
2310023030: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Tank Truck/Railcar Loading: Condensate
2310023100: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-CBM Well Heaters
2310023102: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-CBM Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
2310023202: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
2310023251: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Lateral Compressors 4 Cycle Lean Burn
2310023300: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Pneumatic Devices
2310023302: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
2310023310: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Pneumatic Pumps
2310023351: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Lateral Compressors 4 Cycle Rich Burn
2310023400: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Dehydrators
2310023511: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Fugitives: Connectors
2310023512: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Fugitives: Flanges

2310023513: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Fugitives: Open Ended Lines
2310023515: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Fugitives: Valves
2310023516: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-Fugitives: Other
2310023603: Industrial Processes-Oil and Gas Exploration and Production-Coal Bed Methane Natural Gas-CBM Well Venting - Blowdowns
2310111401: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Oil Exploration-Oil Well Pneumatic Pumps
2310121401: Industrial Processes-Oil and Gas Exploration and Production-On-Shore Gas Exploration-Gas Well Pneumatic Pumps
<b>Industrial Processes - Storage and Transfer</b>
2505030120: Storage and Transport-Petroleum and Petroleum Product Transport-Truck-Gasoline
2505040120: Storage and Transport-Petroleum and Petroleum Product Transport-Pipeline-Gasoline
<b>Miscellaneous Non-Industrial NEC</b>
2501011011: Storage and Transport-Petroleum and Petroleum Product Storage-Residential Portable Gas Cans-Permeation
2501011012: Storage and Transport-Petroleum and Petroleum Product Storage-Residential Portable Gas Cans-Evaporation (includes Diurnal losses)
2501011013: Storage and Transport-Petroleum and Petroleum Product Storage-Residential Portable Gas Cans-Spillage During Transport
2501011014: Storage and Transport-Petroleum and Petroleum Product Storage-Residential Portable Gas Cans-Refilling at the Pump - Vapor Displacement
2501011015: Storage and Transport-Petroleum and Petroleum Product Storage-Residential Portable Gas Cans-Refilling at the Pump - Spillage
2501012011: Storage and Transport-Petroleum and Petroleum Product Storage-Commercial Portable Gas Cans-Permeation
2501012012: Storage and Transport-Petroleum and Petroleum Product Storage-Commercial Portable Gas Cans-Evaporation (includes Diurnal losses)
2501012013: Storage and Transport-Petroleum and Petroleum Product Storage-Commercial Portable Gas Cans-Spillage During Transport
2501012014: Storage and Transport-Petroleum and Petroleum Product Storage-Commercial Portable Gas Cans-Refilling at the Pump - Vapor Displacement
2501012015: Storage and Transport-Petroleum and Petroleum Product Storage-Commercial Portable Gas Cans-Refilling at the Pump - Spillage
2810025000: Miscellaneous Area Sources-Other Combustion-Residential Grilling (see 23-02-002-xxx for Commercial)-Total
2810060100: Miscellaneous Area Sources-Other Combustion-Cremation-Humans
2810060200: Miscellaneous Area Sources-Other Combustion-Cremation-Animals
<b>Solvent - Consumer &amp; Commercial Solvent Use</b>
2460100000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All Personal Care Products-Total: All Solvent Types
2460200000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All Household Products-Total: All Solvent Types

2460400000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All Automotive Aftermarket Products-Total: All Solvent Types
2460500000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All Coatings and Related Products-Total: All Solvent Types
2460600000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All Adhesives and Sealants-Total: All Solvent Types
2460800000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-All FIFRA Related Products-Total: All Solvent Types
2460900000: Solvent Utilization-Miscellaneous Non-industrial: Consumer and Commercial-Miscellaneous Products (Not Otherwise Covered)-Total: All Solvent Types
2461021000: Solvent Utilization-Miscellaneous Non-industrial: Commercial-Cutback Asphalt-Total: All Solvent Types
2461022000: Solvent Utilization-Miscellaneous Non-industrial: Commercial-Emulsified Asphalt-Total: All Solvent Types
2461850000: Solvent Utilization-Miscellaneous Non-industrial: Commercial-Pesticide Application: Agricultural-All Processes
<b>Solvent - Degreasing</b>
2415000000: Solvent Utilization-Degreasing-All Processes/All Industries-Total: All Solvent Types
<b>Solvent - Dry Cleaning</b>
2420000000: Solvent Utilization-Dry Cleaning-All Processes-Total: All Solvent Types
<b>Solvent - Graphic Arts</b>
2425000000: Solvent Utilization-Graphic Arts-All Processes-Total: All Solvent Types
<b>Solvent - Industrial Surface Coating &amp; Solvent Use</b>
2401005000: Solvent Utilization-Surface Coating-Auto Refinishing: SIC 7532-Total: All Solvent Types
2401008000: Solvent Utilization-Surface Coating-Traffic Markings-Total: All Solvent Types
2401015000: Solvent Utilization-Surface Coating-Factory Finished Wood: SIC 2426 thru 242-Total: All Solvent Types
2401020000: Solvent Utilization-Surface Coating-Wood Furniture: SIC 25-Total: All Solvent Types
2401025000: Solvent Utilization-Surface Coating-Metal Furniture: SIC 25-Total: All Solvent Types
2401030000: Solvent Utilization-Surface Coating-Paper: SIC 26-Total: All Solvent Types
2401040000: Solvent Utilization-Surface Coating-Metal Cans: SIC 341-Total: All Solvent Types
2401055000: Solvent Utilization-Surface Coating-Machinery and Equipment: SIC 35-Total: All Solvent Types
2401060000: Solvent Utilization-Surface Coating-Large Appliances: SIC 363-Total: All Solvent Types
2401065000: Solvent Utilization-Surface Coating-Electronic and Other Electrical: SIC 36 - 363-Total: All Solvent Types
2401070000: Solvent Utilization-Surface Coating-Motor Vehicles: SIC 371-Total: All Solvent Types
2401075000: Solvent Utilization-Surface Coating-Aircraft: SIC 372-Total: All Solvent Types
2401080000: Solvent Utilization-Surface Coating-Marine: SIC 373-Total: All Solvent Types
2401085000: Solvent Utilization-Surface Coating-Railroad: SIC 374-Total: All Solvent Types
2401090000: Solvent Utilization-Surface Coating-Miscellaneous Manufacturing-Total: All Solvent Types
2401100000: Solvent Utilization-Surface Coating-Industrial Maintenance Coatings-Total: All Solvent Types

2401200000: Solvent Utilization-Surface Coating-Other Special Purpose Coatings-Total: All Solvent Types
<b>Solvent - Non-Industrial Surface Coating: 2401001000</b>
2401001000: Solvent Utilization-Surface Coating-Architectural Coatings-Total: All Solvent Types
<b>Waste Disposal</b>
2610000100: Waste Disposal, Treatment, and Recovery-Open Burning-All Categories-Yard Waste - Leaf Species Unspecified
2610000400: Waste Disposal, Treatment, and Recovery-Open Burning-All Categories-Yard Waste - Brush Species Unspecified
2610000500: Waste Disposal, Treatment, and Recovery-Open Burning-All Categories-Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)
2610030000: Waste Disposal, Treatment, and Recovery-Open Burning-Residential-Household Waste (use 26-10-000-xxx for Yard Wastes)
2630020000: Waste Disposal, Treatment, and Recovery-Wastewater Treatment-Public Owned-Total Processed
2680003000: Waste Disposal, Treatment, and Recovery-Composting-100% Green Waste (e.g., residential or municipal yard wastes)-All Processes

### 3) Onroad

Emissions from vehicles that travel on public roadways, such as passenger cars and trucks, motorcycles, buses, and large commercial vehicles, are estimated using EPA's Motor Vehicle Emissions System (MOVES) model. The air program submitted model inputs compatible with MOVES20014b. The program followed EPA's instructions for creating and submitting model inputs at [https://www.epa.gov/sites/production/files/2018-08/documents/instructions\\_for\\_onroad\\_inputs\\_to\\_the\\_2017\\_nei\\_20180731.pdf](https://www.epa.gov/sites/production/files/2018-08/documents/instructions_for_onroad_inputs_to_the_2017_nei_20180731.pdf). This document explains choices the program made when creating the model inputs. All files used as model inputs are available for inspection and review upon request to the air program.

The program also followed the August 2018 EPA guidance document "MOVES2014, MOVES2014a, and MOVES2014b Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity" located at <https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves>.

The air program ran the model for the St. Louis area counties after developing the model inputs. Model outputs are derived for a typical ozone season day, a Tuesday in July (dayid=5,

monthid=7). Emissions for the Boles township portion of Franklin county are estimated as 20% of the total Franklin county emissions, as the MOVES model does not estimate partial county emissions.

County Name	CO	NO <sub>x</sub>	VOC
Franklin- Boles only	6.612	1.511	0.603
Jefferson	45.89	8.82	4.27
St. Charles	57.811	10.695	5.017
St. Louis	161.019	33.811	14.156
St. Louis City	40.418	9.825	4.519
<b>Total</b>	<b>311.75</b>	<b>66.66</b>	<b>28.57</b>

The program used EPA default 2017 County Databases (CDBs) as its starting point and only edited tables and fields as necessary. These county databases contain the required MOVES model input tables. The program edited tables including the Inspection and Maintenance (IM) Table (imcoverage), Vehicle Miles Travelled Table (hpmsvtypeyear), Month VMT fraction (monthVMTfrac), Daily VMT Fraction (dayVMTfrac), Hourly VMT Fraction (hourVMTfrac), and Stage II Vapor Recovery Table (countyyear) to include Missouri-specific data and updates. The program also updated the Fuel Usage Fraction Table (fuelusagefraction) and alternative fuel vehicle (avft) tables to eliminate errors with the QA checker.

EPA's instructions for submitting onroad model inputs states that EPA will add 2017 fuels and meteorological data to CDBs before 2017 MOVES runs, so the program did not attempt to create or add this data. EPA is working on a new data methodology to develop vehicle population and age distributions nationwide to apply to the 2016 modeling platform and 2017 NEI, so the program did not attempt to create or replace these tables for the 2017 NEI submittal.

During the January 2019 attempt to submit Missouri-specific CDBs, the EIS QA environment would not allow files larger than 10 MB to be submitted. This was confirmed by an email response from the EPA CDX helpdesk stating that "large EIS file submissions are failing at the EIS backend node. Unfortunately, the EIS backend support team is not available to check the backend not due to the government shutdown." For this reason, only five-county St. Louis area (Franklin 29099, Jefferson 29099, St. Charles 29183, St. Louis County 29189, and St. Louis City 29510) CDBs were submitted in January 2019.

During April 2019, Missouri completed the entire 115 county CDB submittal for the entire state (no tribal areas are in Missouri).

## **IM Table**

Missouri has one five-county area around St. Louis with an IM program. The program updated the default IM coverage table to reflect the latest test report information for the 2016 and 2017 years. The program reports information annually to EPA Region VII to fulfill requirements of 40 CFR 51.366. The following parameters agree with the annual reports.

### *Pollutant Process Types*

Per EPA's August 2018 technical guidance, MOVES estimates emission reductions from IM programs for hydrocarbons, NOx and CO. for exhaust emissions, IM programs affect both running and start emissions. For evaporative emissions, IM programs affect hydrocarbon emissions from fuel vapor venting and fuel leaks. The table below lists the polProcessID codes and their meaning.

<b>polProcessID</b>	<b>Pollutant Code</b>	<b>Pollutant Name</b>	<b>Process Code</b>	<b>Process Name</b>
101	1	Total Gaseous Hydrocarbons	01	Running Exhaust
102	1	Total Gaseous Hydrocarbons	02	Start Exhaust
112	1	Total Gaseous Hydrocarbons	12	Evaporative Vapor Venting
113	1	Total Gaseous Hydrocarbons	13	Evaporative Fuel Leaks
201	2	CO	01	Running Exhaust
202	2	CO	02	Start Exhaust
301	3	NOx	01	Running Exhaust
302	3	NOx	02	Start Exhaust

### *County and Year ID*

The counties covered by the IM program during the 2017 base year in Missouri include Franklin (29071), Jefferson (29099), St. Charles (29183), St. Louis (29189) and the city of St. Louis (29510). The Year ID is 2017.

### *Source and Fuel type*

The MOVES source IDs, or vehicle types, included in the St. Louis area IM program include 21 for passenger cars, 31 for passenger trucks, and 32 for light commercial trucks. The St. Louis area IM program targets only vehicles with Gross Vehicle Weight Rating (GVWR) of less than

8,501 lbs. These include all passenger cars and most passenger trucks, plus a portion of the light commercial truck category. The adjustment for the portion of trucks in each category covered by the IM program is detailed in the compliance rate section below.

Fuel types covered by the St. Louis area IM program include type 1 for gasoline and type 5 for diesel. Diesel is included in the table, despite the August 2018 EPA guidance stating that MOVES currently only estimates IM program benefits for gasoline vehicles.

#### *IM Program Identifier and Test Standard*

The St. Louis area IM program contains program identifiers 8 and 10 that identify two separate test standards. Program identifier 8 is associated with the test standard 43, which is the evaporative system On-Board Diagnostics (OBD) check. Program identifier 10 is associated with the test standard 51, which is the exhaust OBD check. Both of these tests are performed on 1996 and newer OBD-equipped vehicles. The corresponding column, UseIMyn, is marked Y for “Yes” for these two test standards.

#### *Beginning and Ending Model Years*

The St. Louis area IM program applies to gasoline vehicles with a model year of 1996 or later and diesel vehicles with a model year of 1997 or later. The starting year is set to 1996 for fueltypeID 1 for gasoline, and 1997 for fueltypeID 5 for diesel. The ending year reflects the testing requirement exemption for new vehicles within two years of the calendar year. For the emission year of 2017, the two year exemption for new vehicles means the ending model year is 2015 for all fuel and source types.

#### *Inspection Frequency*

The St. Louis area IM program requires emission testing every two years, so the parameter inspectFreq is set to a value of 2.

#### *Compliance Factor*

The August 2018 EPA guidance document gives the procedure to calculate the compliance factor as:

$$\text{Compliance factor} = \text{percent compliance rate} \times (100 - \text{percent waiver rate}) \times \text{regulatory class coverage adjustment}$$

The percent compliance rate is the percent of vehicles in the fleet covered by the IM program that complete the IM program and receive either a certificate of compliance or a waiver. This percentage is included in the annual report:

2016 compliance rate:	99.34%
2017 compliance rate:	99.30%
Average compliance rate:	99.32%

The waiver rate is the percentage of vehicles that fail an initial test and do not pass a retest, but do receive a certificate of compliance. This percentage is included in the annual report:

2016 Waiver Rate:	3.34%
2017 Waiver Rate:	2.15%
Average waiver Rate:	2.78%

Regulatory class coverage adjustment reduces the benefit of the IM program to only those vehicles subject to the IM program. In the St. Louis area, only a portion of the passenger truck and light commercial truck population is subject IM inspection, specifically those under 8,501 lb. GVWR. The August 2018 EPA guidance lists regulatory class adjustment defaults in appendix A.

Passenger car:	100%
Passenger Truck:	98%
Light Commercial Truck:	92%

Calculated compliance factor:

Passenger car:	$99.32\% \times (100\% - 2.78\%) \times 100\% = 96.59\%$
Passenger truck:	$99.32\% \times (100\% - 2.78\%) \times 98\% = 94.63\%$
Light commercial truck:	$99.32\% \times (100\% - 2.78\%) \times 92\% = 88.83\%$

### **HPMSvtypeyear, MonthVMTfrac, DayVMTfrac, and HourVMTfrac Tables**

The Missouri Department of Transportation (MoDOT) provides an estimate of annual average daily vehicle miles travelled (AADVMT) across each county in Missouri. The estimate includes VMT totaled across all vehicle and road types. The program separates total VMT into HPMS vehicle types using a MoDOT estimate of total statewide VMT by vehicle type. The program applies the single distribution of VMT by HPMS vehicle type to all counties in Missouri. The program then uses the EPA tool “aadvm-converter-tool-moves2014” excel tool to create the input tables for MOVES2014b CDBs. The tool creates separate worksheets with the needed inputs for the hpmsvtypeyear, monthvmtfrac, dayvmtfrac, and hourvmtfrac tables. These four tables were exported into .csv files for all counties, then loaded into the CDBs.

For reference, the 2017 AADVMT for the five St. Louis area counties are:

<b>County</b>	<b>2017 AADVMT</b>
Franklin	4,075,950
Jefferson	6,579,895
St. Charles	11,548,351
St. Louis	34,727,735
St. Louis City	8,161,490

The fraction of vehicles by VMT and HPMS vehicle type code are:

<b>HPMSVehicle Type</b>	<b>Fraction</b>
10	0.007775121
25	0.838369969
40	0.004469696
50	0.038115403
60	0.111269811

### **County Year Table**

The program removed all stage 2 vapor controls in the five St. Louis area counties. The May 16, 2012 EPA final rule determined that onboard refueling vapor recovery technology is in widespread use throughout the fleet. With that determination, the program determined that stage 2 controls were not necessary to maintain and improve air quality as onboard vapor recovery was sufficient. The decommissioning of the stage 2 program began in 2013 and was completed by 2016. For the 2017 inventory, the variables “refuelingVaporProgramAdjust” and “refuelingSpillProgramAdjust” are changed from 0.95 and 0.5, respectively, to 0 in the five St. Louis area counties to reflect that the program is no longer operating. See <https://dnr.mo.gov/env/apcp/vaporrecovery/epawidespreaduserule.htm> for details of the program decommissioning.

### **Correcting Errors from the QA Checker**

#### **Fuel Usage Fraction Table**

The EPA-provided default tables had fueleyearid set to 2014 which produced an error in all 115 county databases in the QA check results. The program changed all fueleyearid values to 2017, and the QA error is eliminated.

#### **AVFT Table**

The EPA-provided default tables produce errors in the avft table. Specifically, there are combinations of source type and model year where fuel usage fraction sums to something not equal to one, and some model years are zero in the table. The counties and source types with model years equal to zero are removed from the avft tables below

County	County	County	County	County
29001	29061	29111	29149	29185
29003	29063	29115	29151	29195
29011	29065	29117	29153	29197
29017	29075	29125	29155	29199
29025	29085	29129	29171	29203
29033	29087	29131	29173	29205
29041	29089	29135	29175	20209
29045	29093	29137	29177	29211

County	County	County	County	County
29049	29103	29139	29179	29227
29053	29107	29145	29181	29229

#### 4) Nonroad

Nonroad sources include mobile emissions equipment that is not rated for highway travel. These include agricultural like tractors, recreational equipment like personal watercraft and ATVs, construction and mining equipment, commercial marine vessels, aircraft, and locomotives. While many of these sources are estimated using the MOVES model with the nonroad option, commercial marine vessels, locomotives, and aircraft are estimated outside of the model. Their estimates are based on activity data from marine vessel transponders, locomotive operational data shared via the Federal Railroad Administration, and aircraft takeoff and landing reports from the Federal Aviation Administration. The following table includes a summary of all nonroad emissions in the St. Louis nonattainment area, which have been aggregated for those calculated by the MOVES model, along with those for commercial marine vessels, locomotives, and aircraft. Detailed emission estimates for each of these separate nonroad mobile source categories by SCC, county and pollutant, are available in Appendix B.

County Name	CO	NO <sub>x</sub>	VOC
Franklin- Boles only	2.45	0.64	0.25
Jefferson	24.42	2.06	1.64
St. Charles	55.59	5.63	3.79
St. Louis	303	14.21	16.35
St. Louis City	36.33	3.78	1.86
<b>Total</b>	<b>421.79</b>	<b>26.33</b>	<b>23.89</b>

#### Nonroad Model Output:

The MOVES model nonroad estimates were created using model version 2014b with default database movesdb20180517. The model was run to estimate daily emissions for all vehicle type and fuel type combinations in the nonroad portion of the model for the year 2017. All model defaults were used for 2017, reflecting fuels, vehicle and equipment population and operations, and meteorology included in the model.

The MOVES Nonroad model estimates emissions for entire counties. To estimate the portion of emissions attributable to only Boles Township in Franklin County, several options were

considered. First, the population of Boles Township is approximately 18% of the population of Franklin County according to the 2010 Census. Second, the area of Boles Township at 88 square miles is 9.45% of the area of Franklin County at 931 square miles. Third, the October 2019 Missouri State Implementation Plan Revision titled “Inspection and Maintenance Program for the St. Louis Area – 2019 Revision” (<https://dnr.mo.gov/env/apcp/docs/appendices-1-9.pdf>), Clean Air Act Section 110(l) Demonstration Appendix 3 assumes that 20 percent of the on-road mobile source emissions occur in Boles Township as a reasonable, conservative assumption. For consistency and a conservative estimate, 20% of total Franklin county emissions are assumed to be in Boles Township for the purposes of nonroad estimates.

#### Commercial Marine Vessel Estimates:

2017 Commercial Marine estimates are available from EPA’s Emission Inventory System (EIS). These include emissions from four different SCCs:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2280002101	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Port emissions: Main Engine
2280002102	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Port emissions: Auxiliary Engine
2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine
2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine

#### Railroad and Railyard Estimates:

The 2017 rail emission estimates are compiled by the Eastern Regional Technical Advisory Committee (ERTAC). The ERTAC effort was comprised of a collaborative of state and local air quality agencies, rail company representatives, and the Federal Railroad Administration. Yard emissions are associated with the operation of switcher engines at each yard. Line haul emissions are associated with long distance travel of locomotives for commercial, industrial, and passenger hauling. 2017 activity data and updates were applied to the most recent comprehensive rail inventory, the 2016 base year inventory. The project is documented in a report titled “2017Rail\_main\_21aug2019.pdf” on the 2017 Supplemental data FTP site ([ftp://newftp.epa.gov/air/nei/2017/doc/supporting\\_data/point/](ftp://newftp.epa.gov/air/nei/2017/doc/supporting_data/point/)).

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
28500201	Internal Combustion Engines	Railroad Equipment	Diesel	Yard Locomotives

2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations
2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II / III Operations
2285002008	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Passenger Trains (Amtrak)

#### Aircraft Sector Estimates:

The aircraft sector includes all aircraft types used for public, private, and military purposes. This includes four types of aircraft: (1) commercial, (2) air taxi (AT), (3) general aviation (GA), and (4) military. A critical detail about the aircraft is whether each aircraft is turbine- or piston-driven, which allows the emissions estimation model to assign the fuel used, jet fuel or aviation gas, respectively. The fraction of turbine- and piston-driven aircraft is either collected or assumed for all aircraft types.

Commercial aircraft include those used for transporting passengers, freight, or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air taxis carry passengers, freight, or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft. General aviation includes most other aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, and they sometimes have activity at non-military airports.

The national AT and GA fleets include both jet- and piston-powered aircraft. Most of the AT and GA fleets are made up of larger piston-powered aircraft, though smaller business jets can also be found in these categories. Military aircraft cover a wide range of aircraft types such as training aircraft, fighter jets, helicopters, and jet- and piston-powered planes of varying sizes.

The NEI also includes emission estimates for aircraft auxiliary power units (APUs) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles and equipment, aircraft towing vehicles, and passenger buses. These APUs and GSE are located at the airport facilities along with the aircraft exhaust emissions.

Aircraft exhaust, GSE, and APU emissions estimates are associated with aircrafts' landing and takeoff (LTO) cycle. LTO data were available from both S/L/T agencies and FAA databases. For airports where the available LTO included detailed aircraft-specific make and model information (e.g., Boeing 747-200 series), we used the FAA's Aviation Environmental Design Tool (AEDT) to estimate emissions. Note that this is the first NEI to use this model. 2008 and 2011 used the FAA's previous model, Emissions and Dispersion Modeling System (EDMS). Therefore, comparisons of aircraft emissions output may be a function of model revisions, rather than an actual trend in emissions. For airports where FAA databases do not include such detail, the EPA used assumptions regarding the percent of LTOs that were associated with

piston-driven (using aviation gas) versus turbine-driven (using jet fuel) aircraft. Then, the EPA estimated emissions based on the percent of each aircraft type, LTOs, and emissions factors used. The complete methodology for estimating aircraft exhaust from LTOs is in the aircraft documentation available in the document “2017Aircraft\_main\_19aug2019.pdf” on the 2017 Supplemental data FTP site ([ftp://newftp.epa.gov/air/nei/2017/doc/supporting\\_data/point/](ftp://newftp.epa.gov/air/nei/2017/doc/supporting_data/point/)). Only Texas and California submitted aircraft emissions, and the state of Missouri accepts EPA’s estimate for these emission sources. The MOVES Nonroad emission estimates include airport ground support equipment.

The SCCs included in the nonroad aircraft emission estimates include:

<b>SCC</b>	<b>SCC Level 1</b>	<b>SCC Level 2</b>	<b>SCC Level 3</b>	<b>SCC Level 4</b>
2275001000	Mobile Sources	Aircraft	Military Aircraft	Total
2275020000	Mobile Sources	Aircraft	Commercial Aircraft	Total: All Types
2275050011	Mobile Sources	Aircraft	General Aviation	Piston
2275050012	Mobile Sources	Aircraft	General Aviation	Turbine
2275060011	Mobile Sources	Aircraft	Air Taxi	Piston
2275060012	Mobile Sources	Aircraft	Air Taxi	Turbine
2275070000	Mobile Sources	Aircraft	Aircraft Auxiliary Power Units	Total

## Appendix B

### Detailed 2017 Ozone Season Day Emission Estimates

- This document is labeled Appendix B (follows documentation in A) that gets referenced throughout Appendix A.
- All emissions here are for ozone season day, tons, Franklin County is only the portion in Boles Township (20% assumption).
- Appendix A contains emission summaries (county totals), but not the SCC level details here.

Point

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
FRANKLIN	29071	0003	1350	6032111	AMEREN MISSOURI LABADIE PLANT	LABADIE BOTTOM ROAD	221112	Fossil Fuel Electric Power Generation	7.20	21.85	0.86
FRANKLIN	29071	0031	1373	5150011	GRAPHIC PACKAGING INTERNATIONAL PACIFIC	1101 SOUTH DENTON ROAD	322212	Folding Paperboard Box Manufacturing	-	-	0.11
FRANKLIN	29071	0230	7747	15446211	PLAZE, INC PACIFIC	1000 INTEGRAM DR	325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	0.00	0.00	0.32
Franklin County (Boles Township Area) Total									7.20	21.86	1.29
JEFFERSON	29099	0002	2550	7272311	RIVER CEMENT CO. DBA BUZZI UNICEM USA SELMA PLANT	1000 RIVER CEMENT ROAD	327310	CEMENT MANUFACTURING	3.23	9.05	0.86
JEFFERSON	29099	0003	2551	5258211	DOE RUN COMPANY HERCULANEUM SMELTER	881 MAIN ST	331420	Copper Rolling, Drawing, Extruding, and Alloying	0.01	0.01	0.00

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
JEFFERSON	29099	0011	2557	5258511	UNION PACIFIC RAILROAD CO DESOTO CAR SHOP	491 N MAIN	336510	RAILROAD ROLLING STOCK MANUFACTURING	-	-	0.11
JEFFERSON	29099	0014	2560	7271811	DOW CHEMICAL COMPANY, THE RIVERSIDE PLANT	500 DOW INDUSTRIAL DRIVE	326140	POLYSTYRENE FOAM PRODUCT MANUFACTURING	-	-	0.00
JEFFERSON	29099	0016	2562	5258811	AMEREN MISSOURI RUSH ISLAND PLANT	HWY 61 AT AA VIA BIG HOLLOW RD	221112	Fossil Fuel Electric Power Generation	4.60	12.85	0.55
JEFFERSON	29099	0044	2585	7272511	METAL CONTAINER CORPORATION ARNOLD	42 TENBROOK INDUSTRIAL	332431	Metal Can Manufacturing	0.05	0.07	0.49
JEFFERSON	29099	0052	2590	7272611	ENGINEERED COIL COMPANY D.B.A. DRS MARLO COIL	6060 HWY PP	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	-	-	0.01
JEFFERSON	29099	0068	2605	8112911	ARDAGH GLASS INC. PEVELY	1500 ARDAGH GROUP DRIVE	327213	Glass Container Manufacturing	0.01	0.37	0.07
JEFFERSON	29099	0111	2640	7271911	CARONDELET CORPORATION PEVELY	8600 COMMERCIAL BLVD	331513	Steel Foundries (except Investment)	0.01	0.01	0.13
JEFFERSON	29099	0174	8155	16936811	SUPERIOR SOLVENTS AND CHEMICALS ARNOLD	3023 ARNOLD TENBROOK RD	424690	Other Chemical and Allied Products Merchant Wholesalers	-	-	0.02
Jefferson County Total									7.91	22.37	2.24
ST CHARLES	29183	0001	3866	6783411	AMEREN MISSOURI SIOUX PLANT	HWY 94	221112	Fossil Fuel Electric Power Generation	2.26	18.67	0.50

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST CHARLES	29183	0004	3867	6783511	FRED WEBER INC O'FALLON ASPHALT PLANT	1600 WEST TERRA LANE	324121	Asphalt Paving Mixture and Block Manufacturing	0.16	0.01	0.00
ST CHARLES	29183	0010	3873	6783911	BOEING COMPANY ST. CHARLES	2600 NORTH THIRD ST	336411	Aircraft Manufacturing	0.00	0.00	0.03
ST CHARLES	29183	0027	3889	7273311	SUNEDISON SEMICONDUCTOR ST. PETERS PLANT	501 PEARL DR	334413	Semiconductor and Related Device Manufacturing	0.01	0.01	0.00
ST CHARLES	29183	0076	3926	7284511	GENERAL MOTORS LLC WENTZVILLE CENTER	1500 E RT A	336111	Automobile Manufacturing	0.20	0.24	2.66
ST CHARLES	29183	0077	3927	8100411	O'FALLON CASTING LLC	600 CANNONBALL LANE	331523	Nonferrous Metal Die-Casting Foundries	-	-	0.08
ST CHARLES	29183	0129	3974	7387111	WOODBIDGE CORPORATION ST. PETERS	11 CERMAK BOULEVARD	326140	POLYSTYRENE FOAM PRODUCT MANUFACTURING	-	-	0.32
ST CHARLES	29183	0131	3976	6797711	SUPERIOR HOME PRODUCTS INC	211 EDINGER ROAD	326121	Unlaminated Plastics Profile Shape Manufacturing	-	-	0.05
ST CHARLES	29183	0184	6193	7387311	TRUE MANUFACTURING CO O'FALLON	301 CANNONBALL LANE	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing	0.00	0.00	0.04
ST CHARLES	29183	0206	6637	7389411	ITW LABELS ST. CHARLES	#1 RESEARCH PARK DRIVE DOCK 3	323111	Commercial Gravure Printing	-	-	0.01
ST CHARLES	29183	6003	4030	7390011	LAMI WOOD PRODUCTS	1 LAMI INDUSTRIAL DRIVE	337110	WOOD KITCHEN CABINET AND COUNTERTOP MANUFACTURING	-	-	0.01
<b>St. Charles County Total</b>									<b>2.64</b>	<b>18.94</b>	<b>3.71</b>

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS COUNTY	29189	0010	4139	6816611	AMEREN MISSOURI MERAMEC PLANT	8200 FINE RD	221112	Fossil Fuel Electric Power Generation	4.44	4.42	0.10
ST LOUIS COUNTY	29189	0020	4149	6828811	MONSANTO WORLD HEADQUARTERS LINDBERGH BLVD	800 N LINDBERGH BLVD	541713	Research and Development in Biotechnology (except Nanobiotechnology)	0.02	0.03	0.00
ST LOUIS COUNTY	29189	0032	4161	6829311	MONSANTO CHESTERFIELD VILLAGE	700 CHESTERFIELD PARKWAY	541713	Research and Development in Biotechnology (except Nanobiotechnology)	0.03	0.02	0.00
ST LOUIS COUNTY	29189	0035	4164	8100611	HUNTSMAN PIGMENTS AND ADDITIVES E HOFFMEISTER	303 E HOFFMEISTER	325130	Synthetic Dye and Pigment Manufacturing	0.01	0.02	0.00
ST LOUIS COUNTY	29189	0042	4171	6829611	WASHINGTON UNIVERSITY DANFORTH CAMPUS	6500 FOREST PARK PARKWAY	611310	COLLEGES, UNIVERSITIES, AND PROFESSIONAL SCHOOLS	0.05	0.11	0.01
ST LOUIS COUNTY	29189	0057	4175	6829711	ST. LOUIS POST-DISPATCH DUNLAP IND DR	11700 DUNLAP IND DR	511110	NEWSPAPER PUBLISHERS	0.00	0.00	0.00
ST LOUIS COUNTY	29189	0064	4182	6829911	SUNNEN PRODUCTS COMPANY MAPLEWOOD	7910 MANCHESTER RD	333517	Machine Tool Manufacturing	0.00	0.00	0.03
ST LOUIS COUNTY	29189	0065	4183	7387411	ST. LOUIS AIRPORT AUTHORITY LAMBERT INTERNATIONAL BLVD	10701 LAMBERT INTERNATIONAL BLVD	488190	OTHER SUPPORT ACTIVITIES FOR AIR TRANSPORTATION	0.03	0.08	0.05

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS COUNTY	29189	0069	4187	6830011	THE QUIKRETE COMPANIES, INC. VALLEY PARK	701 MARSHALL RD	212321	Construction Sand and Gravel Mining	0.01	0.01	0.00
ST LOUIS COUNTY	29189	0111	4201	7688111	MISSOURI ASPHALT PRODUCTS, LLC WEST LAKE QUARRY & MATERIAL CO	13570 ST. CHARLES ROCK RD	324121	Asphalt Paving Mixture and Block Manufacturing	0.13	0.01	0.00
ST LOUIS COUNTY	29189	0141	4229	7703011	ENERGY PETROLEUM COMPANY KIENLEN	2130 KIENLEN	424710	Petroleum Bulk Stations and Terminals	-	-	0.02
ST LOUIS COUNTY	29189	0217	4257	5366611	METROPOLITAN ST. LOUIS SEWER DISTRICT LEMAY WWTP	201 HOFFMEISTER AVE	221320	SEWAGE TREATMENT FACILITIES	1.46	0.24	0.09
ST LOUIS COUNTY	29189	0230	4266	5113911	THE BOEING COMPANY ST. LOUIS	LINDBERGH & MCDONNELL BLVD	336411	Aircraft Manufacturing	0.05	0.11	0.21
ST LOUIS COUNTY	29189	0238	4273	5114011	ST. LOUIS LITHOGRAPHING COMPANY HEEGE AVENUE	6880 HEEGE AVENUE	323111	Commercial Gravure Printing	-	-	0.06
ST LOUIS COUNTY	29189	0281	4309	5114711	BFI MISSOURI PASS LANDFILL MARYLAND HEIGHTS	2520 ADIE ROAD	562212	Solid Waste Landfill	0.00	0.01	0.01
ST LOUIS COUNTY	29189	0308	4328	7387811	IESI MO CHAMP LANDFILL ST. LOUIS COUNTY	2305 CREVE COEUR MILL RD	562212	Solid Waste Landfill	0.75	0.04	0.02

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS COUNTY	29189	0310	4330	5115911	ADVANCED DISPOSAL SERVICES OAK RIDGE LANDFILL	1741 SULPHUR SPRINGS ROAD	562212	Solid Waste Landfill	0.13	0.02	0.04
ST LOUIS COUNTY	29189	0312	4332	5116011	BRIDGETON LANDFILL, LLC	13570 ST.CHARLES ROCK RD	562212	Solid Waste Landfill	0.10	0.03	0.01
ST LOUIS COUNTY	29189	0315	4335	7400611	FOL TAPE LLC FENTON	2025 HITZERT CT	327215	Glass Product Manufacturing Made of Purchased Glass	-	-	0.04
ST LOUIS COUNTY	29189	0317	4337	5116311	PRO-TECT MFG INC FERGUSON AVE	1251 FERGUSON AVE	326299	ALL OTHER RUBBER PRODUCT MANUFACTURING	-	-	0.06
ST LOUIS COUNTY	29189	0318	4338	5116411	SSM HEALTH ST MARYS HOSPITAL	6420 CLAYTON RD	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.01	0.02	0.02
ST LOUIS COUNTY	29189	1012	4360	5278311	BELTSERVICE CORP	4143 RIDERTRAIL NORTH	326220	RUBBER AND PLASTICS HOSES AND BELTING MANUFACTURING	0.00	0.00	0.12
ST LOUIS COUNTY	29189	1029	4371	5278611	SSM HEALTH DEPAUL HOSPITAL - ST. LOUIS BRIDGETON	12303 DEPAUL DRIVE	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.01	0.01	0.00
ST LOUIS COUNTY	29189	1097	4411	7286211	REICHHOLD LLC 2 VALLEY PARK	249 ST. LOUIS AVE	325211	Plastics Material and Resin Manufacturing	0.01	0.02	0.11
ST LOUIS COUNTY	29189	1101	4412	5279511	ST. LUKE'S HOSPITAL WOODS MILL ROAD	232 WOODS MILL ROAD	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.02	0.02	0.00

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS COUNTY	29189	1205	4472	6822111	MSD, MISSOURI RIVER WWTP MO RIVER WASTERWATER TREATMENT PLANT	3455 CREVE COEUR MILL ROAD	221320	SEWAGE TREATMENT FACILITIES	0.03	0.16	0.02
ST LOUIS COUNTY	29189	1226	6036	6822811	SIMPSON CONSTRUCTION MATERIALS LLC VALLEY PARK	699 NORTH OUTER ROAD	324121	Asphalt Paving Mixture and Block Manufacturing	0.25	0.07	0.02
ST LOUIS COUNTY	29189	1248	4509	6824011	FRED WEBER INC. - SOUTH ASPHALT (BATCH) SOUTH ASPHALT	4200 NEW BAUMGARTNER RD	324121	Asphalt Paving Mixture and Block Manufacturing	0.19	0.01	0.00
ST LOUIS COUNTY	29189	1249	4510	6824111	FRED WEBER INC - NORTH ASPHALT H AND B NORTH ASPHALT, H&B	2305 CREVE COUER MILL RD	324121	Asphalt Paving Mixture and Block Manufacturing	0.29	0.04	0.01
ST LOUIS COUNTY	29189	1250	4511	6824211	FRED WEBER INC. - NORTH ASPHALT B-G NORTH ASPHALT, B-G	2305 CREVE COEUR MILL RD	324121	Asphalt Paving Mixture and Block Manufacturing	0.08	0.01	0.00
ST LOUIS COUNTY	29189	1489	6388	7578011	GKN AEROSPACE NORTH AMERICA, INC. BERKELEY	142 JS MCDONNELL BOULEVARD	336413	Other Aircraft Part and Auxiliary Equipment Manufacturing	0.02	0.01	0.14
ST LOUIS COUNTY	29189	1516	6717	7578911	J.D. STRETT AND COMPANY INC LEMAY	#1 RIVER ROAD	424710	Petroleum Bulk Stations and Terminals	-	-	0.02

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS COUNTY	29189	1591	8059	16534111	AMEREN MISSOURI MARYLAND HEIGHTS ENERGY CENTER	2320 CREVE COEUR MILL RD	221118	Other Electric Power Generation	0.06	0.01	0.06
<b>St. Louis County Total</b>									<b>8.18</b>	<b>5.54</b>	<b>1.30</b>
ST LOUIS CITY	29510	0003	5181	7765811	ANHEUSER-BUSCH INC ST. LOUIS	1 BUSCH PLACE	312120	BREWERIES	0.20	0.34	0.66
ST LOUIS CITY	29510	0017	5190	8398811	MALLINCKRODT LLC N SECOND	3600 N 2ND ST	325412	Pharmaceutical Preparation Manufacturing	0.06	0.08	0.15
ST LOUIS CITY	29510	0027	5197	7304011	PRECOAT METALS	4301 S SPRING	332812	METAL COATING, ENGRAVING (EXCEPT JEWELRY AND SILVERWARE), AND ALLIED SERVICES TO MANUFACTURERS	0.02	0.03	0.10
ST LOUIS CITY	29510	0031	5200	6009311	ADM GRAIN COMPANY ST. LOUIS	ONE EAST GRAND	424510	Grain and Field Bean Merchant Wholesalers	0.00	0.00	0.00
ST LOUIS CITY	29510	0038	5206	6009611	ASHLEY ENERGY LLC	1 ASHLEY PL	221330	STEAM AND AIR-CONDITIONING SUPPLY	0.23	0.26	0.02
ST LOUIS CITY	29510	0040	5207	6009711	WASHINGTON UNIV MEDICAL SCHOOL BOILER PLANT	500 S EUCLID	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.04	0.17	0.01
ST LOUIS CITY	29510	0047	5208	6009811	FRED WEBER INC KINGSHIGHWAY ASPHALT	1337 S KINGSHIGHWAY	324121	Asphalt Paving Mixture and Block Manufacturing	0.03	0.00	0.00
ST LOUIS CITY	29510	0053	5209	6009911	METROPOLITAN ST. LOUIS SEWER DISTRICT BISSELL POINT WWTP	10 E GRAND	221320	SEWAGE TREATMENT FACILITIES	2.02	0.39	0.07

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS CITY	29510	0057	5212	7766411	PROCTER AND GAMBLE ST. LOUIS	169 E GRAND AVE	325611	Soap and Other Detergent Manufacturing	0.06	0.07	0.00
ST LOUIS CITY	29510	0066	5219	7301011	ELEMENTIS SPECIALTIES INC	5548 MANCHESTER	325998	ALL OTHER MISCELLANEOUS CHEMICAL PRODUCT AND PREPARATION MANUFACTURING	0.02	0.02	0.28
ST LOUIS CITY	29510	0070	5222	6110211	ICL PERFORMANCE PRODUCTS LP CARONDELET PLANT	8201 IDAHO AVE	325180	Other Basic Inorganic Chemical Manufacturing	0.07	0.03	0.00
ST LOUIS CITY	29510	0096	5241	7767411	ELANTAS PDG, INC. SECOND ST	5200 N SECOND ST	325510	PAINT AND COATING MANUFACTURING	0.01	0.01	0.02
ST LOUIS CITY	29510	0097	5242	7767511	U S PAINT CORPORATION ST. LOUIS	831 S TWENTY-FIRST	325510	PAINT AND COATING MANUFACTURING	-	-	0.20
ST LOUIS CITY	29510	0118	5259	6123811	JW ALUMINUM ST. LOUIS	6100 S BROADWAY	331315	Aluminum Sheet, Plate, and Foil Manufacturing	0.04	0.06	0.67
ST LOUIS CITY	29510	0162	5271	6124311	MARQUETTE TOOL AND DIE	3185 S KINGSHIGHWAY BLVD	333511	Industrial Mold Manufacturing	-	-	0.01
ST LOUIS CITY	29510	0179	5284	6124811	ITALGRANI ELEVATOR USA US DURUM	7900 VAN BUREN	424510	Grain and Field Bean Merchant Wholesalers	0.00	0.00	0.01
ST LOUIS CITY	29510	0204	5302	6125311	BARNES JEWISH HOSPITAL	ONE BARNES JEWISH HOSPITAL PLAZA	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.19	0.67	0.02
ST LOUIS CITY	29510	0269	5316	6125511	SENSIENT COLORS LLC JEFFERSON PLANT	2515 NORTH JEFFERSON AVE	325130	Synthetic Dye and Pigment Manufacturing	-	0.09	0.00

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS CITY	29510	0391	5337	6126211	HERMANN OAK LEATHER CO	4050 NORTH FIRST	316110	LEATHER AND HIDE TANNING AND FINISHING	0.00	0.00	0.02
ST LOUIS CITY	29510	0697	5368	7768911	SIGMA - ALDRICH MFG LLC DEKALB FACILITY	3500 DEKALB	325199	ALL OTHER BASIC ORGANIC CHEMICAL MANUFACTURING	0.03	0.03	0.02
ST LOUIS CITY	29510	0808	5383	5341711	CHEMISPHERE CORPORATION	2101 CLIFTON AVENUE	424690	Other Chemical and Allied Products Merchant Wholesalers	-	-	0.03
ST LOUIS CITY	29510	0809	5384	5341811	PQ CORPORATION (THE) ST. LOUIS	4238 GERALDINE	325180	Other Basic Inorganic Chemical Manufacturing	0.03	0.26	0.01
ST LOUIS CITY	29510	1055	5418	5342911	GOODWIN PRINTING CO. ST. LOUIS	2613 N BROADWAY	323111	Commercial Gravure Printing	-	-	0.01
ST LOUIS CITY	29510	1077	5421	5343111	MID-WEST INDUSTRIAL CHEMICAL	1509-11 SUBLETTE AVE	325520	ADHESIVE MANUFACTURING	-	-	0.01
ST LOUIS CITY	29510	1088	5422	7300911	SCHAEFFER MFG	102 BARTON	324191	Petroleum Lubricating Oil and Grease Manufacturing	0.00	0.00	0.14
ST LOUIS CITY	29510	1093	5426	5343211	BRENNTAG MID-SOUTH INC	139 E SOPER	424690	Other Chemical and Allied Products Merchant Wholesalers	-	-	0.02
ST LOUIS CITY	29510	1123	5429	5129911	U. S. RINGBINDER LP	6800 ARSENAL	323111	Commercial Gravure Printing	-	-	0.02
ST LOUIS CITY	29510	1407	5470	5132111	SOUTHERN METAL PROCESSING	6323 S BROADWAY	331410	Nonferrous Metal (except Aluminum) Smelting and Refining	0.00	0.00	0.00
ST LOUIS CITY	29510	1505	5481	5132511	SSM HEALTH ST. LOUIS UNIVERSITY HOSPITAL	3628 RUTGER	622110	GENERAL MEDICAL AND SURGICAL HOSPITALS	0.08	0.09	0.00
ST LOUIS CITY	29510	1556	5487	5146111	CONNECTOR CASTINGS	1600 N. 22D STREET	331523	Nonferrous Metal Die-Casting Foundries	-	0.00	0.01

County Name	County Code	State Facility Site Identifier	State Site Identifier	EIS Facility Site Identifier	Facility Site Name	Address	NAICS Code	NAICS Description	Emissions (tons per ozone season day)		
									CO	NO <sub>x</sub>	VOC
ST LOUIS CITY	29510	1642	5498	5146411	J S ALBERICI CONSTRUCTION	2150 KIENLEN	237310	HIGHWAY, STREET, AND BRIDGE CONSTRUCTION	-	0.00	0.04
ST LOUIS CITY	29510	1761	5511	5146911	NESTLE PURINA PETCARE COMPANY ST. LOUIS	901 CHOUTEAU	311111	Dog and Cat Food Manufacturing	0.01	0.01	0.00
ST LOUIS CITY	29510	2378	5556	7833811	BRANDONVIEW, LLC GALLERY 720 BUILDING	720 OLIVE	221112	Fossil Fuel Electric Power Generation	0.80	0.52	0.00
ST LOUIS CITY	29510	2433	5563	7834011	RIVIANA FOODS INC.	611 EAST MARCEAU STREET	311824	Dry Pasta, Dough, and Flour Mixes Manufacturing	0.01	0.01	0.00
ST LOUIS CITY	29510	2545	5582	7834611	SOUTHWESTERN BELL TELEPHONE COMPANY	801 CHESTNUT	517311	WIRED TELECOMMUNICATIONS CARRIERS	0.00	0.00	0.00
ST LOUIS CITY	29510	2662	5612	16937011	BKEP MATERIALS, LLC ST. LOUIS TERMINAL CO	201 E. NAGEL	424710	Petroleum Bulk Stations and Terminals	0.00	0.01	0.00
ST LOUIS CITY	29510	2711	6305	7835511	SAINT LOUIS UNIVERSITY FACILITIES SERVICES	3545 LINDELL BLVD, SUITE 210	611310	COLLEGES, UNIVERSITIES, AND PROFESSIONAL SCHOOLS	0.01	0.01	0.00
ST LOUIS CITY	29510	2752	6754	17628111	SHELTER WORKS	2616 S 3RD ST	326199	All Other Plastics Product Manufacturing	-	-	0.05
ST LOUIS CITY	29510	2939	7732	16937211	KINDER MORGAN TRANSMIX CO ST. LOUIS	4070 S 1ST	424710	Petroleum Bulk Stations and Terminals	0.01	0.01	0.07
St. Louis City Total									3.94	3.19	2.71
Area Total									29.87	71.9	11.25

Comparison of the 2011 and 2017 Base Year Point Source Inventories

(The sources listed in the following table were included in the 2011 base year emissions inventory in Missouri's Marginal Ozone Nonattainment Area Plan for the St. Louis Area for the 2008 Ozone Standard)

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
071	0003	AMEREN MISSOURI – LABADIE PLANT	Y	P70	Active	Included in both 2011 and 2017 inventories.
071	0013	SPORLAN DIVISION PLANT #1	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0014	CANAM STEEL CORP	Not Applicable	P70	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0020	STEELWELD EQUIPMENT CO INC	Not Applicable	Intermediate	OB	Out of business.
071	0031	GRAPHIC PACKAGING INTERNATIONAL	Y	P70	Active	Included in both 2011 and 2017 inventories.
071	0068	MERAMEC INDUSTRIES INC	Not Applicable	Intermediate	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0080	SPARTAN SHOWCASE INC	Not Applicable	Intermediate	OB	Out of business.
071	0087	BULL MOOSE TUBE COMPANY	Not Applicable	Intermediate	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0131	SULLIVAN PRECISION METAL FINISHING INC	Not Applicable	Intermediate	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0132	SPORLAN VALVE DIVISION	Not Applicable	P70	OB	Out of business.
071	0151	AEROFIL TECHNOLOGY INC	Not Applicable	P70	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0153	MAGNET LLC	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0154	PRECISION STONE FABRICATORS	Not Applicable	Construction, No Operating Permit	OB	Out of business.
071	0155	EATON FUNERAL HOME	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0157	PLAZE INCORPORATED	Not Applicable	P70	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0173	HENNIGES AUTOMOTIVE SEALING SYSTEMS NA	Not Applicable	Intermediate	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0178	SPORLAN VALVE DIVISION	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
071	0181	CG POWER SYSTEMS USA INC	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0195	AMTECO INC	Not Applicable	Construction, No Operating Permit	OB	Out of business.
071	0205	TRUE MANUFACTURING COMPANY	Not Applicable	Construction, No Operating Permit	Active	Not applicable because 2017 inventory only includes Boles Township sources.
071	0230	PLAZE, INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
099	0002	RIVER CEMENT CO. DBA BUZZI UNICEM USA	Y	P70	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0003	DOE RUN COMPANY	Y	Construction, No Operating Permit	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0007	FRED WEBER INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0011	UNION PACIFIC RAILROAD CO	Y	Intermediate	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0012	TRAUTMAN QUARRY	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0014	DOW CHEMICAL COMPANY, THE	Y	P70	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0016	AMEREN MISSOURI – RUSH ISLAND PLANT	Y	P70	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0044	METAL CONTAINER CORPORATION	Y	P70	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
099	0052	ENGINEERED COIL COMPANY	Y	Intermediate	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0068	SAINT-GOBAIN CONTAINERS INC	Y	P70	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0072	SHAPIRO BROTHERS INC	N	No Operating Permit	Active	See footnote. <sup>1</sup>
099	0092	MASTERCHEM INDUSTRIES INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0098	FRED WEBER INC	N	Basic	OB	Out of business.
099	0103	BUSSEN QUARRIES INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0111	CARONDELET CORPORATION	Y	Intermediate	Active	Due to comment, Jefferson County was included in 2017 inventory for this State Implementation Plan and the facility was included in both 2011 and 2017 inventories.
099	0114	AERO METAL FINISHING	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0116	SINCLAIR & RUSH	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
099	0174	SUPERIOR SOLVENTS AND CHEMICALS ARNOLD	New in 2017 inventory	Intermediate	Active	Operations at the Arnold facility began reporting emissions in the state inventory system (MoEIS) in 2012.
183	0001	AMEREN MISSOURI – SIOUX PLANT	Y	P70	Active	Included in both 2011 and 2017 inventories.
183	0004	FRED WEBER INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
183	0010	BOEING COMPANY	Y	P70	Active	Included in both 2011 and 2017 inventories.
183	0012	MIDWEST PRECISION CASTING COMPANY	N	No Operating Permit	Active	See footnote. <sup>1</sup>
183	0019	ST. JOSEPH HEALTH CENTER	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
183	0023	MAGELLAN TERMINALS HOLDINGS LP	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
183	0027	MEMC ELECTRONIC MATERIALS INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
183	0029	RECKITT BENCKISER	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
183	0038	LEONARD'S METAL INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
183	0076	GENERAL MOTORS LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
183	0077	O'FALLON CASTING LLC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
183	0110	ZOLTEK CORPORATION	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
183	0129	WOODBIDGE CORPORATION	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
183	0131	SUPERIOR HOME PRODUCTS INC	Y	P70	Active	Included in both 2011 and 2017 inventories.
183	0184	TRUE MANUFACTURING CO	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
183	,0206	ITW LABELS ST. CHARLES	New in 2017 inventory	Construction, No Operating Permit	Active	In 2017, this facility updated from a Basic Operating Permit to an Intermediate Operating Permit. Later in 2019, this facility no longer needed to have a Basic Operating Permit due to the removal of the Basic Operating Permit requirements from the Operating Permit rule, and subsequently, the facility permit type changed to a state construction only permit.
183	0241	PITMAN CREMATION SERVICES	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
183	6003	LAMI WOOD PRODUCTS	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0010	AMEREN MISSOURI – MERAMEC PLANT	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	0020	MONSANTO WORLD HEADQUARTERS	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0022	ST. JOHNS MERCY MEDICAL CNTR/MAINTENANCE	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	0023	AMEREN MISSOURI	N	P70	OB	Out of business.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
189	0032	MONSANTO	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0035	ROCKWOOD PIGMENTS NA INC	Y	Intermediate	OB	Out of business.
189	0040	PACE CONSTRUCTION CO.	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	0042	WASHINGTON UNIVERSITY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0057	ST. LOUIS POST-DISPATCH	Y	No Operating Permit	Active	Included in both 2011 and 2017 inventories.
189	0061	CARAUSTAR INDUSTRIES INC.	N	Construction, No Operating Permit	OB	Out of business.
189	0064	SUNNEN PRODUCTS COMPANY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0065	ST. LOUIS AIRPORT AUTHORITY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0069	THE QUIKRETE COMPANIES, INC.	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0111	MISSOURI ASPHALT PRODUCTS, LLC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0140	STOUT MARKETING	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	0141	ENERGY PETROLEUM COMPANY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0201	PACE CONSTRUCTION CO	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	0208	PRINTPACK INC	N	P70	OB	Out of business.
189	0217	METROPOLITAN ST. LOUIS SEWER DISTRICT	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	0226	GREIF-FENTON	N	P70	OB	Out of business.
189	0230	THE BOEING COMPANY	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	0231	CHRYSLER GROUP LLC	N	P70	OB	Out of business.
189	0238	ST. LOUIS LITHOGRAPHING COMPANY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0281	BFI MISSOURI PASS LANDFILL	Y	No Operating Permit	Active	Included in both 2011 and 2017 inventories.
189	0282	CENVEO ST. LOUIS	N	Intermediate	OB	Out of business.
189	0308	IESI MO CHAMP LANDFILL	Y	P70	Active	Included in both 2011 and 2017 inventories.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
189	0310	ADVANCED DISPOSAL SERVICES	Y	Construction, No Operating Permit	Active	Included in both 2011 and 2017 inventories.
189	0312	BRIDGETON LANDFILL, LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	0315	FOL TAPE LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	0317	PRO-TECT MFG INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0318	ST. MARYS HEALTH CENTER	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	0326	AIR PRODUCTS-PRISM MEMBRANES	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	0327	CAMIE-CAMPBELL INC	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1012	BELT SERVICE CORP	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	1015	KV PHARMACEUTICAL COMPANY	N	Intermediate	OB	Out of business.
189	1029	SSM DEPAUL HEALTH CENTER	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1047	NESHER PHARMACEUTICALS	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1065	MISSOURI AIR NATIONAL GUARD	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1071	INTELLIGRATED	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1093	BODINE ALUMINUM INC	N	Construction, No Operating Permit	OB	Out of business.
189	1097	REICHOLD, INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1101	ST. LUKE'S HOSPITAL	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1196	MALLINCKRODT LLC	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1204	BASF PESTICIDE CONTROL SOLUTIONS	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1205	MSD, MISSOURI RIVER WWTP	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	1210	MSD, COLDWATER CREEK WWTP	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1226	SIMPSON CONSTRUCTION MATERIALS LLC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1247	QUEST LITHOGRAPHICS LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
189	1248	FRED WEBER INC. - SOUTH ASPHALT (BATCH)	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1249	FRED WEBER INC - NORTH ASPHALT H AND B	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1250	FRED WEBER INC. - NORTH ASPHALT B-G	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1259	MACLAN INDUSTRIES	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1269	GLIDEAWAY MFG COMPANY	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1316	SINCLAIR AND RUSH	N	Construction, No Operating Permit	OB	Out of business.
189	1470	SOUTHERN GRAPHIC SYSTEMS	N	Construction, No Operating Permit	OB	Out of business.
189	1474	LACLEDE GAS COMPANY - UGS	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1481	MANOR CHEMICAL COMPANY INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1489	GKN AEROSPACE NORTH AMERICA, INC.	Y	P70	Active	Included in both 2011 and 2017 inventories.
189	1501	PEERLESS PARK LANDFILL	N	Construction, No Operating Permit	OB	Out of business.
189	1515	FRED WEBER INC. - CRUSHING PLANT #7	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1516	J.D. STREETT AND COMPANY INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
189	1520	F AND S PRINTING	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1521	PACE CONSTRUCTION CO	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1523	MISSOURI VALLEY ASPHALT LLC	N	No Operating Permit	OB	Out of business.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
189	1534	A.G. RECYCLING	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1538	NESHER PHARMACEUTICALS	N	No Operating Permit	Active	See footnote. <sup>1</sup>
189	1541	PACKAGING CONCEPTS INC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1590	CENVEO - ST. LOUIS	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
189	1591	AMEREN MISSOURI MARYLAND HEIGHTS ENERGY CENTER	New in 2017 inventory	Construction, No Operating Permit	Active	This facility began reporting emission in MoEIS in 2012, was permitted that same year, and was considered together with the landfill 189-0308, for operating permits. In 2016, this facility changed it's site name from Landfill Gas to Energy Facility to Maryland Heights Energy Center. Later in 2019, the facility was determined to be a state construction only permit based on being separate from the landfill, and having new source review conditions controlling emissions.
510	0003	ANHEUSER-BUSCH INC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0016	J.D. STREETT	N	Intermediate	Active	This facility updated from No Operating Permit to a Basic Operating permit in 2014, and later in 2019 to an Intermediate Operating permit.
510	0017	MALLINCKRODT LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0027	PRECOAT METALS	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0031	ADM GRAIN COMPANY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0035	BUCKEYE TERMINALS LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0036'	BUCKEYE TERMINALS LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0038	TRIGEN-ST. LOUIS ENERGY CORP	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0040	WASHINGTON UNIV MEDICAL SCHOOL	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0047	FRED WEBER INC	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
510	0053	METROPOLITAN ST. LOUIS SEWER DISTRICT	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0057	PROCTER AND GAMBLE	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0063	THE DIAL CORPORATION	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0066	ELEMENTIS SPECIALTIES INC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0070	ICL PERFORMANCE PRODUCTS LP	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0096	ELANTAS PDG, INC.	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0097	U S PAINT CORPORATION	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0106	UNIVERSAL PRINTING CO INC	N	Construction, No Operating Permit	OB	Out of business.
510	0118	JW ALUMINUM	Y	P70	OB	Out of business.
510	0161	POLY ONE CORPORATION	N	No Operating Permit	Active	See footnote. <sup>1</sup>
510	0162	MARQUETTE TOOL AND DIE	Y	P70	OB	Out of business.
510	0175	ST. LOUIS METALLIZING COMPANY	N	Intermediate	OB	Out of business.
510	0179	ITALGRANI ELEVATOR USA	Y	Construction, No Operating Permit	Active	Included in both 2011 and 2017 inventories.
510	0200	ST. ALEXIUS HOSPITAL	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0204	BARNES JEWISH HOSPITAL	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0269	SENSIENT COLORS LLC	Y	Construction, No Operating Permit	Active	Included in both 2011 and 2017 inventories.
510	0391	HERMANN OAK LEATHER CO	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0405	ABLE RACK CO	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0468	LANGE-STEGMANN COMPANY	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0561	INDUSTRIAL CONTAINER SERVICES - MO, LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
510	0671	HAMMERTS IRON WORKS	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	0697	SIGMA - ALDRICH MFG LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0746	PEPSI BEVERAGES COMPANY	N	No Operating Permit	Active	See footnote. <sup>1</sup>
510	0808	CHEMISPHERE CORPORATION	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	0809	PQ CORPORATION (THE)	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	0938	INTERSTATE BRANDS CORP	N	Intermediate	OB	Out of business.
510	1011	MICROFINISH IPC LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	1055	GOODWIN PRINTING CO.	Y	Construction, No Operating Permit	OB	Out of business.
510	1077	MID-WEST INDUSTRIAL CHEMICAL	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	1088	SCHAEFFER MFG	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	1093	BRENNTAG MID-SOUTH INC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	1123	U. S. RINGBINDER LP	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	1216	U S POLYMERS-ACCUREZ, LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	1270	HUMANE SOCIETY OF MISSOURI	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	1280	ST. LOUIS POST DISPATCH	N	No Operating Permit	Active	See footnote. <sup>1</sup>
510	1370	NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	1407	SOUTHERN METAL PROCESSING	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	1423	NEXEO SOLUTIONS, LLC	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	1460	ALLIED HEALTH CARE PRODUCTS	N	No Operating Permit	Active	See footnote. <sup>1</sup>
510	1505	ENERGY CENTER (THE)	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.

FIPS	Plant ID	Facility Site Name	In 2017 Point Source Inventory?	Latest Permit Type	Current Status	Notes
510	1518	NIES/ARTCRAFT	N	Construction, No Operating Permit	OB	Out of business.
510	1556	CONNECTOR CASTINGS	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	1642	J S ALBERICI CONSTRUCTION	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	1761	NESTLE PURINA PETCARE COMPANY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	2111	ADVERTISERS DISPLAY AND EXHIBIT INC	N	No Operating Permit	Active	See footnote. <sup>1</sup>
510	2300	SUPERIOR SOLVENT AND CHEMICAL	N	Intermediate	OB	Out of business.
510	2378	HERTZ ST. LOUIS ONE, LLC	Y	P70	Active	Included in both 2011 and 2017 inventories.
510	2433	NEW WORLD PASTA	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	2545	SOUTHWESTERN BELL TELEPHONE COMPANY	N	Intermediate	Active	This facility had zero emissions in the 2011 inventory, and was later updated from a Part 70 Operating Permit to an Intermediate Operating permit in 2018. This facility was not included in the 2017 inventory for this SIP because they recoreded insignificant emissions and due to rounding were inadvertently left off. However, this facility has now been added to the 2017 inventory for this SIP.
510	2662	BKEP MATERIALS, LLC	Y	Construction, No Operating Permit	Active	Included in both 2011 and 2017 inventories.
510	2664	TRIAD MANUFACTURING	N	Construction, No Operating Permit	Active	See footnote. <sup>1</sup>
510	2711	ST. LOUIS UNIVERSITY	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.
510	2752	SHELTER WORKS	New in 2017 inventory	P70	Active	This facility was a very small source and had zero emissions in the 2011 inventory. In 2015, the facility permit was updated from No Operating Permit to a Part 70 Operating Permit.
510	2833	WASHINGTON UNIVERSITY	N	Intermediate	OB	Out of business.
510	2939	KINDER MORGAN TRANSMIX CO	Y	Intermediate	Active	Included in both 2011 and 2017 inventories.

<sup>1</sup> Updates were made to the 2017 National Emissions Inventory (NEI) submittal procedures compared to the emission collection processes for the 2011 NEI and 2014 NEI data submittals in the accounting of small sources in the point and nonpoint categories. Due to this process change, many small sources previously in the point source category are now located in the nonpoint source category.

## Nonpoint

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types	0.000	0.000	0.000
Franklin	2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types	0.001	0.006	0.000
Franklin	2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	0.025	0.029	0.002
Franklin	2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Boiler Types	0.000	0.001	0.000
Franklin	2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers	0.000	0.000	0.000
Franklin	2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
Franklin	2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines	0.008	0.009	0.001
Franklin	2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.000	0.001	0.000
Franklin	2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types	0.005	0.002	0.000
Franklin	2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types	0.000	0.000	0.000
Franklin	2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types	0.000	0.000	0.000
Franklin	2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/Subbituminous Coal	Total: All Combustor Types	0.000	0.000	0.000
Franklin	2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types	0.000	0.000	0.000
Franklin	2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types	0.000	0.001	0.000
Franklin	2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.000	0.001	0.000
Franklin	2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general	0.008	0.000	0.001
Franklin	2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified	0.002	0.000	0.001

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	0.006	0.000	0.000
Franklin	2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	0.003	0.000	0.000
Franklin	2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified	0.010	0.000	0.002
Franklin	2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic	0.024	0.000	0.002
Franklin	2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic	0.012	0.000	0.001
Franklin	2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)	0.001	0.000	0.000
Franklin	2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	0.008	0.000	0.001
Franklin	2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general	0.001	0.000	0.000
Franklin	2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor	0.016	0.000	0.003
Franklin	2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor	0.010	0.000	0.002

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired	0.000	0.000	0.000
Franklin	2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimeas, etc)	0.011	0.000	0.001
Franklin	2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types	0.000	0.000	0.000
Franklin	2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types	0.000	0.000	0.000
Franklin	2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling	0.002		0.001
Franklin	2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling	0.006		0.002
Franklin	2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying			0.000
Franklin	2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying	0.001		0.000
Franklin	2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying			0.000
Franklin	2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types			0.067
Franklin	2401005000	Solvent Utilization	Surface Coating	Auto Refinishing: SIC 7532	Total: All Solvent Types			0.013
Franklin	2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types			0.012
Franklin	2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood: SIC 2426 thru 242	Total: All Solvent Types			0.000
Franklin	2401020000	Solvent Utilization	Surface Coating	Wood Furniture: SIC 25	Total: All Solvent Types			0.012

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2401025000	Solvent Utilization	Surface Coating	Metal Furniture: SIC 25	Total: All Solvent Types			0.011
Franklin	2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment: SIC 35	Total: All Solvent Types			0.000
Franklin	2401065000	Solvent Utilization	Surface Coating	Electronic and Other Electrical: SIC 36 - 363	Total: All Solvent Types			0.002
Franklin	2401070000	Solvent Utilization	Surface Coating	Motor Vehicles: SIC 371	Total: All Solvent Types			0.018
Franklin	2401075000	Solvent Utilization	Surface Coating	Aircraft: SIC 372	Total: All Solvent Types			0.001
Franklin	2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types			0.000
Franklin	2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types			0.010
Franklin	2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types			0.000
Franklin	2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types			0.054
Franklin	2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types			0.000
Franklin	2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types			0.306
Franklin	2460100000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types			0.055
Franklin	2460200000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types			0.056
Franklin	2460400000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types			0.005

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2460500000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types			0.026
Franklin	2460600000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types			0.048
Franklin	2460800000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types			0.050
Franklin	2460900000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	Miscellaneous Products (Not Otherwise Covered)	Total: All Solvent Types			0.002
Franklin	2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types			0.053
Franklin	2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types			0.063
Franklin	2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes			0.021
Franklin	2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation			0.002
Franklin	2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)			0.002
Franklin	2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport			0.002
Franklin	2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.000
Franklin	2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation			0.000
Franklin	2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)			0.000
Franklin	2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport			0.003
Franklin	2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.001
Franklin	2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage			0.000
Franklin	2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline			0.005
Franklin	2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline			0.002
Franklin	2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling			0.001
Franklin	2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling			0.000
Franklin	2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling			0.007
Franklin	2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying			0.009
Franklin	2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total			0.004
Franklin	2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline			0.001
Franklin	2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline			0.002
Franklin	2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Leaf Species Unspecified	0.007	0.000	0.002
Franklin	2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Brush Species Unspecified	0.007	0.000	0.002
Franklin	2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	0.730	0.018	0.050
Franklin	2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)	0.130	0.009	0.010
Franklin	2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed			0.001
Franklin	2680003000	Waste Disposal, Treatment, and Recovery	Composting	100% Green Waste (e.g., residential or municipal yard wastes)	All Processes			0.000
Franklin	2801500000	Miscellaneous Area Sources	Agriculture Production - Crops - as nonpoint	Agricultural Field Burning - whole field set on fire	Unspecified crop type and Burn Method	0.000	0.000	0.000
Franklin	2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified			0.017

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin	2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement			0.000
Franklin	2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement			0.000
Franklin	2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement			0.000
Franklin	2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified			0.009
Franklin	2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)			0.040
Franklin	2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified			0.002
Franklin	2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total			0.000
Franklin	2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified			0.001
Franklin	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total	0.017	0.000	0.001
Franklin	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans	0.000	0.000	0.000
Franklin	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Franklin County Total (Boles Township Only)						1.052	0.081	1.082
Jefferson	2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types	0.000	0.001	0.000
Jefferson	2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types	0.005	0.022	0.002
Jefferson	2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	0.089	0.106	0.006
Jefferson	2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Boiler Types	0.002	0.003	0.000
Jefferson	2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.002	0.003	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers	0.000	0.000	0.000
Jefferson	2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines	0.000	0.000	0.000
Jefferson	2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
Jefferson	2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines	0.056	0.067	0.004
Jefferson	2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.003	0.006	0.000
Jefferson	2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types	0.039	0.014	0.001

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types	0.000	0.000	0.000
Jefferson	2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types	0.000	0.000	0.000
Jefferson	2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/Subbituminous Coal	Total: All Combustor Types	0.000	0.000	0.000
Jefferson	2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types	0.000	0.000	0.000
Jefferson	2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types	0.006	0.014	0.001
Jefferson	2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.001	0.005	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general	0.101	0.002	0.013
Jefferson	2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified	0.027	0.000	0.006
Jefferson	2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	0.063	0.001	0.005
Jefferson	2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	0.032	0.001	0.004
Jefferson	2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified	0.072	0.001	0.016
Jefferson	2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic	0.168	0.002	0.012

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic	0.084	0.001	0.010
Jefferson	2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)	0.004	0.001	0.001
Jefferson	2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	0.051	0.000	0.003
Jefferson	2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general	0.004	0.001	0.001
Jefferson	2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor	0.096	0.001	0.018
Jefferson	2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor	0.062	0.000	0.012

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired	0.000	0.000	0.000
Jefferson	2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimeas, etc)	0.116	0.002	0.015
Jefferson	2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types	0.001	0.000	0.000
Jefferson	2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types	0.000	0.001	0.000
Jefferson	2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling	0.015		0.004
Jefferson	2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling	0.043		0.013

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying			0.003
Jefferson	2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying	0.004		0.002
Jefferson	2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying			0.000
Jefferson	2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types			0.726
Jefferson	2401005000	Solvent Utilization	Surface Coating	Auto Refinishing: SIC 7532	Total: All Solvent Types			0.088
Jefferson	2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types			0.134

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood: SIC 2426 thru 242	Total: All Solvent Types			0.001
Jefferson	2401020000	Solvent Utilization	Surface Coating	Wood Furniture: SIC 25	Total: All Solvent Types			0.052
Jefferson	2401040000	Solvent Utilization	Surface Coating	Metal Cans: SIC 341	Total: All Solvent Types			0.000
Jefferson	2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment: SIC 35	Total: All Solvent Types			0.015
Jefferson	2401060000	Solvent Utilization	Surface Coating	Large Appliances: SIC 363	Total: All Solvent Types			0.001
Jefferson	2401070000	Solvent Utilization	Surface Coating	Motor Vehicles: SIC 371	Total: All Solvent Types			0.006

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2401075000	Solvent Utilization	Surface Coating	Aircraft: SIC 372	Total: All Solvent Types			0.001
Jefferson	2401080000	Solvent Utilization	Surface Coating	Marine: SIC 373	Total: All Solvent Types			0.002
Jefferson	2401085000	Solvent Utilization	Surface Coating	Railroad: SIC 374	Total: All Solvent Types			0.053
Jefferson	2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types			0.000
Jefferson	2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types			0.112
Jefferson	2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types			0.002

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types			0.156
Jefferson	2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types			0.000
Jefferson	2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types			0.124
Jefferson	2460100000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types			0.590
Jefferson	2460200000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types			0.601
Jefferson	2460400000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types			0.057

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2460500000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types			0.286
Jefferson	2460600000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types			0.548
Jefferson	2460800000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types			0.536
Jefferson	2460900000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	Miscellaneous Products (Not Otherwise Covered)	Total: All Solvent Types			0.021
Jefferson	2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types			0.385
Jefferson	2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types			0.463

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes			0.015
Jefferson	2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation			0.022
Jefferson	2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)			0.025
Jefferson	2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport			0.019
Jefferson	2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.003
Jefferson	2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage			0.001

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation			0.001
Jefferson	2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)			0.001
Jefferson	2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport			0.038
Jefferson	2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.013
Jefferson	2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage			0.001
Jefferson	2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline			0.544

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline			0.249
Jefferson	2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling			0.004
Jefferson	2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling			0.000
Jefferson	2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling			0.040
Jefferson	2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying			0.051
Jefferson	2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total			0.012

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total			0.000
Jefferson	2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline			0.003
Jefferson	2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline			0.257
Jefferson	2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Leaf Species Unspecified	0.038	0.002	0.010
Jefferson	2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Brush Species Unspecified	0.038	0.002	0.010
Jefferson	2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	6.448	0.157	0.442

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)	0.761	0.054	0.056
Jefferson	2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed			0.005
Jefferson	2680003000	Waste Disposal, Treatment, and Recovery	Composting	100% Green Waste (e.g., residential or municipal yard wastes)	All Processes			0.000
Jefferson	2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified			0.022
Jefferson	2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement			0.001
Jefferson	2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement			0.002
Jefferson	2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified			0.010
Jefferson	2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)			0.005
Jefferson	2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified			0.006
Jefferson	2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total			0.004
Jefferson	2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Jefferson	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total	0.170	0.004	0.009
Jefferson	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans	0.001	0.001	0.000
Jefferson	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals	0.000	0.000	0.000
<b>Jefferson County Totals</b>						8.600	0.474	6.994
St. Charles	2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types	0.001	0.003	0.000
St. Charles	2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types	0.012	0.055	0.004
St. Charles	2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	0.221	0.263	0.014
St. Charles	2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Boiler Types	0.004	0.007	0.000
St. Charles	2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.006	0.012	0.000
St. Charles	2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers	0.000	0.000	0.000
St. Charles	2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines	0.000	0.000	0.000
St. Charles	2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
St. Charles	2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines	0.194	0.231	0.013
St. Charles	2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.011	0.020	0.001
St. Charles	2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types	0.134	0.049	0.004
St. Charles	2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Charles	2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/Subbituminous Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Charles	2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types	0.000	0.000	0.000
St. Charles	2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types	0.023	0.053	0.003
St. Charles	2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.001	0.003	0.000
St. Charles	2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general	0.165	0.003	0.021
St. Charles	2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified	0.018	0.000	0.004
St. Charles	2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	0.043	0.001	0.003
St. Charles	2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	0.022	0.000	0.003
St. Charles	2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified	0.058	0.001	0.013
St. Charles	2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic	0.137	0.002	0.010

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic	0.068	0.001	0.008
St. Charles	2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)	0.004	0.001	0.001
St. Charles	2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	0.047	0.000	0.003
St. Charles	2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general	0.004	0.001	0.001
St. Charles	2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor	0.089	0.000	0.017
St. Charles	2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor	0.057	0.000	0.011
St. Charles	2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired	0.000	0.000	0.000
St. Charles	2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimneys, etc)	0.169	0.003	0.021
St. Charles	2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types	0.002	0.000	0.001
St. Charles	2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types	0.000	0.001	0.000
St. Charles	2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling	0.046		0.014

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling	0.133		0.041
St. Charles	2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying			0.009
St. Charles	2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying	0.011		0.005
St. Charles	2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying			0.000
St. Charles	2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types			1.284
St. Charles	2401005000	Solvent Utilization	Surface Coating	Auto Refinishing: SIC 7532	Total: All Solvent Types			0.238
St. Charles	2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types			0.236
St. Charles	2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood: SIC 2426 thru 242	Total: All Solvent Types			0.001
St. Charles	2401020000	Solvent Utilization	Surface Coating	Wood Furniture: SIC 25	Total: All Solvent Types			0.024
St. Charles	2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment: SIC 35	Total: All Solvent Types			0.153
St. Charles	2401070000	Solvent Utilization	Surface Coating	Motor Vehicles: SIC 371	Total: All Solvent Types			0.000
St. Charles	2401075000	Solvent Utilization	Surface Coating	Aircraft: SIC 372	Total: All Solvent Types			0.011
St. Charles	2401080000	Solvent Utilization	Surface Coating	Marine: SIC 373	Total: All Solvent Types			0.015
St. Charles	2401085000	Solvent Utilization	Surface Coating	Railroad: SIC 374	Total: All Solvent Types			0.018
St. Charles	2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types			0.000
St. Charles	2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types			0.197

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types			0.003
St. Charles	2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types			0.413
St. Charles	2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types			0.004
St. Charles	2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types			1.777
St. Charles	2460100000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types			1.043
St. Charles	2460200000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types			1.062
St. Charles	2460400000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types			0.101
St. Charles	2460500000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types			0.506
St. Charles	2460600000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types			0.969
St. Charles	2460800000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types			0.948
St. Charles	2460900000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	Miscellaneous Products (Not Otherwise Covered)	Total: All Solvent Types			0.037

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types			0.616
St. Charles	2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types			0.740
St. Charles	2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes			0.156
St. Charles	2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation			0.044
St. Charles	2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)			0.050
St. Charles	2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport			0.039
St. Charles	2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.006
St. Charles	2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage			0.001
St. Charles	2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation			0.002
St. Charles	2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)			0.002
St. Charles	2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport			0.076
St. Charles	2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.027
St. Charles	2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage			0.003

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline			0.025
St. Charles	2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline			0.011
St. Charles	2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling			0.006
St. Charles	2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling			0.000
St. Charles	2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling			0.064
St. Charles	2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying			0.082
St. Charles	2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total			0.063
St. Charles	2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total			0.000
St. Charles	2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline			0.005
St. Charles	2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline			0.012
St. Charles	2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Leaf Species Unspecified	0.012	0.001	0.003
St. Charles	2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Brush Species Unspecified	0.012	0.001	0.003

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	7.419	0.180	0.509
St. Charles	2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)	0.242	0.017	0.018
St. Charles	2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed			0.017
St. Charles	2680003000	Waste Disposal, Treatment, and Recovery	Composting	100% Green Waste (e.g., residential or municipal yard wastes)	All Processes			0.000
St. Charles	2801500171	Miscellaneous Area Sources	Agriculture Production - Crops - as nonpoint	Agricultural Field Burning - whole field set on fire	Fallow	0.034	0.001	0.005
St. Charles	2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified			0.026
St. Charles	2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement			0.000
St. Charles	2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement			0.002
St. Charles	2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement			0.000
St. Charles	2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified			0.014

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Charles	2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)			0.116
St. Charles	2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified			0.002
St. Charles	2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total			0.000
St. Charles	2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified			0.003
St. Charles	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total	0.296	0.006	0.016
St. Charles	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans	0.001	0.001	0.000
St. Charles	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals	0.000	0.000	0.000
<b>St. Charles Total</b>						<b>9.698</b>	<b>0.920</b>	<b>12.032</b>
St. Louis	2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types	0.002	0.009	0.000
St. Louis	2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types	0.037	0.172	0.012
St. Louis	2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	0.692	0.824	0.045
St. Louis	2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Boiler Types	0.012	0.022	0.001
St. Louis	2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.026	0.056	0.000
St. Louis	2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers	0.000	0.000	0.000
St. Louis	2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines	0.000	0.000	0.000
St. Louis	2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
St. Louis	2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines	0.901	1.072	0.059
St. Louis	2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.051	0.092	0.003
St. Louis	2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types	0.621	0.228	0.018
St. Louis	2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Louis	2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/Subbituminous Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Louis	2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types	0.000	0.000	0.000
St. Louis	2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types	0.072	0.170	0.010
St. Louis	2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.001	0.004	0.000
St. Louis	2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general	0.359	0.006	0.046
St. Louis	2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified	0.047	0.001	0.011
St. Louis	2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	0.110	0.002	0.008
St. Louis	2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	0.055	0.001	0.007
St. Louis	2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified	0.105	0.001	0.024
St. Louis	2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic	0.247	0.003	0.018

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic	0.123	0.002	0.015
St. Louis	2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)	0.020	0.005	0.003
St. Louis	2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	0.007	0.000	0.000
St. Louis	2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general	0.001	0.000	0.000
St. Louis	2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor	0.013	0.000	0.002
St. Louis	2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor	0.008	0.000	0.002
St. Louis	2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired	0.000	0.000	0.000
St. Louis	2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimneas, etc)	0.012	0.000	0.001
St. Louis	2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types	0.007	0.000	0.002
St. Louis	2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types	0.000	0.001	0.000
St. Louis	2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling	0.119		0.036

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling	0.373		0.114
St. Louis	2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying			0.025
St. Louis	2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying	0.031		0.015
St. Louis	2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying			0.001
St. Louis	2310000551	Industrial Processes	Oil and Gas Exploration and Production	All Processes	Produced Water from CBM Wells			0.000
St. Louis	2310000552	Industrial Processes	Oil and Gas Exploration and Production	All Processes	Produced Water from Gas Wells			0.000
St. Louis	2310000553	Industrial Processes	Oil and Gas Exploration and Production	All Processes	Produced Water from Oil Wells			0.001
St. Louis	2310010100	Industrial Processes	Oil and Gas Exploration and Production	Crude Petroleum	Oil Well Heaters	0.001	0.001	0.000
St. Louis	2310010200	Industrial Processes	Oil and Gas Exploration and Production	Crude Petroleum	Oil Well Tanks - Flashing & Standing/Working/Breathing	0.000	0.000	0.005
St. Louis	2310010300	Industrial Processes	Oil and Gas Exploration and Production	Crude Petroleum	Oil Well Pneumatic Devices			0.010
St. Louis	2310011001	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Associated Gas Venting	0.000	0.000	0.001
St. Louis	2310011201	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Tank Truck/Railcar Loading: Crude Oil			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2310011501	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Fugitives: Connectors			0.000
St. Louis	2310011502	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Fugitives: Flanges			0.000
St. Louis	2310011503	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Fugitives: Open Ended Lines			0.000
St. Louis	2310011505	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Fugitives: Valves			0.003
St. Louis	2310011600	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Production	Artificial Lift Engines	0.009	0.006	0.000
St. Louis	2310021010	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Storage Tanks: Condensate	0.000	0.000	0.000
St. Louis	2310021030	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Tank Truck/Railcar Loading: Condensate			0.000
St. Louis	2310021100	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Gas Well Heaters	0.000	0.000	0.000
St. Louis	2310021102	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310021202	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310021251	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Lateral Compressors 4 Cycle Lean Burn	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2310021300	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Gas Well Pneumatic Devices			0.000
St. Louis	2310021302	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310021351	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Lateral Compressors 4 Cycle Rich Burn	0.000	0.000	0.000
St. Louis	2310021400	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Gas Well Dehydrators	0.000	0.000	0.000
St. Louis	2310021501	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Fugitives: Connectors			0.000
St. Louis	2310021502	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Fugitives: Flanges			0.000
St. Louis	2310021503	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Fugitives: Open Ended Lines			0.000
St. Louis	2310021505	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Fugitives: Valves			0.000
St. Louis	2310021506	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Fugitives: Other			0.000
St. Louis	2310021603	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Production	Gas Well Venting - Blowdowns	0.000	0.000	0.000
St. Louis	2310023000	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Dewatering Pump Engines	0.000	0.000	0.000
St. Louis	2310023010	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Storage Tanks: Condensate	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2310023030	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Tank Truck/Railcar Loading: Condensate			0.000
St. Louis	2310023100	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	CBM Well Heaters	0.000	0.000	0.000
St. Louis	2310023102	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	CBM Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310023202	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310023251	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Lateral Compressors 4 Cycle Lean Burn	0.000	0.000	0.000
St. Louis	2310023300	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Pneumatic Devices			0.000
St. Louis	2310023302	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP	0.000	0.000	0.000
St. Louis	2310023310	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Pneumatic Pumps			0.000
St. Louis	2310023351	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Lateral Compressors 4 Cycle Rich Burn	0.000	0.000	0.000
St. Louis	2310023400	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Dehydrators	0.000	0.000	0.000
St. Louis	2310023511	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Fugitives: Connectors			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2310023512	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Fugitives: Flanges			0.000
St. Louis	2310023513	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Fugitives: Open Ended Lines			0.000
St. Louis	2310023515	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Fugitives: Valves			0.000
St. Louis	2310023516	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	Fugitives: Other			0.000
St. Louis	2310023603	Industrial Processes	Oil and Gas Exploration and Production	Coal Bed Methane Natural Gas	CBM Well Venting - Blowdowns	0.000	0.000	0.000
St. Louis	2310111401	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Oil Exploration	Oil Well Pneumatic Pumps			0.001
St. Louis	2310121401	Industrial Processes	Oil and Gas Exploration and Production	On-Shore Gas Exploration	Gas Well Pneumatic Pumps			0.000
St. Louis	2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types			3.235
St. Louis	2401005000	Solvent Utilization	Surface Coating	Auto Refinishing: SIC 7532	Total: All Solvent Types			0.993
St. Louis	2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types			0.595
St. Louis	2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood: SIC 2426 thru 242	Total: All Solvent Types			0.006
St. Louis	2401020000	Solvent Utilization	Surface Coating	Wood Furniture: SIC 25	Total: All Solvent Types			0.174
St. Louis	2401025000	Solvent Utilization	Surface Coating	Metal Furniture: SIC 25	Total: All Solvent Types			0.192
St. Louis	2401030000	Solvent Utilization	Surface Coating	Paper: SIC 26	Total: All Solvent Types			0.266
St. Louis	2401040000	Solvent Utilization	Surface Coating	Metal Cans: SIC 341	Total: All Solvent Types			0.024

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment: SIC 35	Total: All Solvent Types			0.117
St. Louis	2401060000	Solvent Utilization	Surface Coating	Large Appliances: SIC 363	Total: All Solvent Types			0.001
St. Louis	2401065000	Solvent Utilization	Surface Coating	Electronic and Other Electrical: SIC 36 - 363	Total: All Solvent Types			0.000
St. Louis	2401070000	Solvent Utilization	Surface Coating	Motor Vehicles: SIC 371	Total: All Solvent Types			0.076
St. Louis	2401075000	Solvent Utilization	Surface Coating	Aircraft: SIC 372	Total: All Solvent Types			0.277
St. Louis	2401080000	Solvent Utilization	Surface Coating	Marine: SIC 373	Total: All Solvent Types			0.033
St. Louis	2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types			0.000
St. Louis	2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types			0.497
St. Louis	2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types			0.008
St. Louis	2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types			2.191
St. Louis	2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types			0.020
St. Louis	2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types			8.647
St. Louis	2460100000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types			2.629
St. Louis	2460200000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types			2.678

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2460400000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types			0.254
St. Louis	2460500000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types			1.275
St. Louis	2460600000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types			2.398
St. Louis	2460800000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types			2.389
St. Louis	2460900000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	Miscellaneous Products (Not Otherwise Covered)	Total: All Solvent Types			0.094
St. Louis	2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types			1.940
St. Louis	2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types			2.331
St. Louis	2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes			0.018
St. Louis	2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation			0.254
St. Louis	2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)			0.285
St. Louis	2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport			0.222

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.037
St. Louis	2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage			0.006
St. Louis	2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation			0.011
St. Louis	2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)			0.009
St. Louis	2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport			0.435
St. Louis	2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.154
St. Louis	2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage			0.017
St. Louis	2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline			0.962
St. Louis	2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline			0.451
St. Louis	2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling			0.022
St. Louis	2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling			0.000
St. Louis	2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling			0.227
St. Louis	2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying			0.291

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total			0.160
St. Louis	2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total			0.000
St. Louis	2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline			0.019
St. Louis	2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline			0.465
St. Louis	2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Leaf Species Unspecified	0.003	0.000	0.001
St. Louis	2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Brush Species Unspecified	0.003	0.000	0.001
St. Louis	2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	4.946	0.120	0.339
St. Louis	2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)	0.131	0.009	0.010
St. Louis	2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed			0.072
St. Louis	2680003000	Waste Disposal, Treatment, and Recovery	Composting	100% Green Waste (e.g., residential or municipal yard wastes)	All Processes			0.716
St. Louis	2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified			0.003

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis	2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement			0.000
St. Louis	2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement			0.000
St. Louis	2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement			0.000
St. Louis	2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified			0.000
St. Louis	2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)			0.000
St. Louis	2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified			0.004
St. Louis	2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total			0.000
St. Louis	2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified			0.003
St. Louis	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total	0.808	0.017	0.044
St. Louis	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans	0.002	0.003	0.000
St. Louis	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals	0.000	0.000	0.000
<b>St. Louis County Total</b>						<b>9.956</b>	<b>2.826</b>	<b>39.077</b>

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types	0.001	0.003	0.000
St. Louis city	2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types	0.014	0.064	0.004
St. Louis city	2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines	0.257	0.306	0.017
St. Louis city	2102007000	Stationary Source Fuel Combustion	Industrial	Liquified Petroleum Gas (LPG)	Total: All Boiler Types	0.005	0.008	0.000
St. Louis city	2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	0.010	0.021	0.000
St. Louis city	2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers	0.000	0.000	0.000
St. Louis city	2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types	0.000	0.000	0.000
St. Louis city	2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines	0.339	0.403	0.022
St. Louis city	2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.019	0.034	0.001
St. Louis city	2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types	0.234	0.086	0.007
St. Louis city	2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types	0.000	0.000	0.000
St. Louis city	2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Louis city	2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/Subbituminous Coal	Total: All Combustor Types	0.000	0.000	0.000
St. Louis city	2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types	0.000	0.000	0.000
St. Louis city	2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types	0.022	0.053	0.003
St. Louis city	2104007000	Stationary Source Fuel Combustion	Residential	Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0.000	0.001	0.000
St. Louis city	2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general	0.025	0.000	0.003
St. Louis city	2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified	0.006	0.000	0.001

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic	0.014	0.000	0.001
St. Louis city	2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic	0.007	0.000	0.001
St. Louis city	2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified	0.012	0.000	0.003
St. Louis city	2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic	0.028	0.000	0.002
St. Louis city	2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic	0.014	0.000	0.002
St. Louis city	2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general (freestanding or FP insert)	0.001	0.000	0.000
St. Louis city	2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified	0.000	0.000	0.000
St. Louis city	2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general	0.000	0.000	0.000
St. Louis city	2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor	0.000	0.000	0.000
St. Louis city	2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor	0.000	0.000	0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired	0.000	0.000	0.000
St. Louis city	2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimeas, etc)	0.000	0.000	0.000
St. Louis city	2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types	0.002	0.000	0.000
St. Louis city	2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types	0.000	0.000	0.000
St. Louis city	2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Conveyorized Charbroiling	0.037		0.011
St. Louis city	2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Charbroiling	Under-fired Charbroiling	0.124		0.038
St. Louis city	2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Deep Fat Frying			0.008
St. Louis city	2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Flat Griddle Frying	0.010		0.005
St. Louis city	2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking - Frying	Clamshell Griddle Frying			0.000
St. Louis city	2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types			1.002
St. Louis city	2401005000	Solvent Utilization	Surface Coating	Auto Refinishing: SIC 7532	Total: All Solvent Types			0.074
St. Louis city	2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types			0.184
St. Louis city	2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood: SIC 2426 thru 242	Total: All Solvent Types			0.013
St. Louis city	2401020000	Solvent Utilization	Surface Coating	Wood Furniture: SIC 25	Total: All Solvent Types			0.202

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2401025000	Solvent Utilization	Surface Coating	Metal Furniture: SIC 25	Total: All Solvent Types			0.055
St. Louis city	2401030000	Solvent Utilization	Surface Coating	Paper: SIC 26	Total: All Solvent Types			0.057
St. Louis city	2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment: SIC 35	Total: All Solvent Types			0.000
St. Louis city	2401065000	Solvent Utilization	Surface Coating	Electronic and Other Electrical: SIC 36 - 363	Total: All Solvent Types			0.008
St. Louis city	2401070000	Solvent Utilization	Surface Coating	Motor Vehicles: SIC 371	Total: All Solvent Types			0.014
St. Louis city	2401080000	Solvent Utilization	Surface Coating	Marine: SIC 373	Total: All Solvent Types			0.008
St. Louis city	2401090000	Solvent Utilization	Surface Coating	Miscellaneous Manufacturing	Total: All Solvent Types			0.021
St. Louis city	2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types			0.154
St. Louis city	2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types			0.002
St. Louis city	2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types			0.595
St. Louis city	2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types			0.002
St. Louis city	2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types			2.701
St. Louis city	2460100000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types			0.814
St. Louis city	2460200000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types			0.829

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2460400000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types			0.079
St. Louis city	2460500000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types			0.395
St. Louis city	2460600000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types			0.758
St. Louis city	2460800000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types			0.740
St. Louis city	2460900000	Solvent Utilization	Miscellaneous Non-industrial: Consumer and Commercial	Miscellaneous Products (Not Otherwise Covered)	Total: All Solvent Types			0.029
St. Louis city	2461021000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types			0.316
St. Louis city	2461022000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types			0.380
St. Louis city	2501011011	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Permeation			0.039
St. Louis city	2501011012	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Evaporation (includes Diurnal losses)			0.044
St. Louis city	2501011013	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Spillage During Transport			0.034
St. Louis city	2501011014	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.006

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2501011015	Storage and Transport	Petroleum and Petroleum Product Storage	Residential Portable Gas Cans	Refilling at the Pump - Spillage			0.001
St. Louis city	2501012011	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Permeation			0.002
St. Louis city	2501012012	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Evaporation (includes Diurnal losses)			0.001
St. Louis city	2501012013	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Spillage During Transport			0.067
St. Louis city	2501012014	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Vapor Displacement			0.024
St. Louis city	2501012015	Storage and Transport	Petroleum and Petroleum Product Storage	Commercial Portable Gas Cans	Refilling at the Pump - Spillage			0.003
St. Louis city	2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline			0.217
St. Louis city	2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline			0.107
St. Louis city	2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling			0.005
St. Louis city	2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling			0.000
St. Louis city	2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling			0.053
St. Louis city	2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying			0.069
St. Louis city	2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total			0.019

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 2: Total			0.000
St. Louis city	2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline			0.004
St. Louis city	2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline			0.111
St. Louis city	2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Leaf Species Unspecified	0.000	0.000	0.000
St. Louis city	2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste - Brush Species Unspecified	0.000	0.000	0.000
St. Louis city	2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)	0.000	0.000	0.000
St. Louis city	2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)	0.000	0.000	0.000
St. Louis city	2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed			0.000
St. Louis city	2680003000	Waste Disposal, Treatment, and Recovery	Composting	100% Green Waste (e.g., residential or municipal yard wastes)	All Processes			0.081
St. Louis city	2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified			0.000

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
St. Louis city	2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement			0.000
St. Louis city	2805009100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - broilers	Confinement			0.000
St. Louis city	2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement			0.000
St. Louis city	2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified			0.000
St. Louis city	2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified (see also 28-05-039, -047, -053)			0.000
St. Louis city	2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified			0.000
St. Louis city	2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total			0.000
St. Louis city	2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified			0.000
St. Louis city	2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling - Residential (see 23-02-002-xxx for Commercial)	Total	0.254	0.005	0.014
St. Louis city	2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans	0.001	0.001	0.000
St. Louis city	2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals	0.000	0.000	0.000
<b>St. Louis City Total</b>						<b>1.434</b>	<b>0.989</b>	<b>10.465</b>

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	CO	NOx	VOC
Area Total						30.741	5.289	69.649



# Nonroad Model

County Name	SCC	SCC level 1	SCC level 2	SCC level 3	SCC level 4	Nonroad Equipment Group	CO	NOx	VOC
Franklin	2260001010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.05	0.00	0.05
Franklin	2260001030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.03	0.00	0.01
Franklin	2260001060	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.02	0.00	0.00
Franklin	2260002006	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
Franklin	2260002009	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
Franklin	2260002021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2260002027	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Franklin	2260002039	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.01	0.00	0.00
Franklin	2260002054	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2260003030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Franklin	2260003040	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2260004015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2260004016	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.00	0.00	0.00

Franklin	2260004020	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2260004021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2260004025	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.01	0.00	0.00
Franklin	2260004026	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2260004030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.01	0.00	0.00
Franklin	2260004031	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2260004035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2260004036	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2260004071	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2260005035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2260006005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Franklin	2260006010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
Franklin	2260006015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Franklin	2260006035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00

Franklin	2260007005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Logging Equipment	Chain Saws : 6 HP	Logging Equipment	0.00	0.00	0.00
Franklin	2265001010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.02	0.00	0.00
Franklin	2265001030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.23	0.00	0.02
Franklin	2265001050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Golf Carts	Recreational Vehicles	0.09	0.00	0.00
Franklin	2265001060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.02	0.00	0.00
Franklin	2265002003	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
Franklin	2265002006	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
Franklin	2265002009	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
Franklin	2265002015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
Franklin	2265002021	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.01	0.00	0.00
Franklin	2265002024	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2265002027	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Franklin	2265002030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00
Franklin	2265002033	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.00	0.00	0.00

Franklin	2265002039	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.01	0.00	0.00
Franklin	2265002042	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.00	0.00	0.00
Franklin	2265002045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
Franklin	2265002054	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2265002057	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
Franklin	2265002060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
Franklin	2265002066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.00	0.00	0.00
Franklin	2265002072	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.00	0.00	0.00
Franklin	2265002078	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.00	0.00	0.00
Franklin	2265002081	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2265003010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.02	0.00	0.00
Franklin	2265003020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Forklifts	Industrial Equipment	0.01	0.00	0.00
Franklin	2265003030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.00	0.00
Franklin	2265003040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.04	0.00	0.00

Franklin	2265003050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2265003060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
Franklin	2265003070	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Franklin	2265004010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Residential)	Lawn and Garden	0.08	0.00	0.01
Franklin	2265004011	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Commercial)	Lawn and Garden	0.03	0.00	0.00
Franklin	2265004015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265004016	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.02	0.00	0.00
Franklin	2265004025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004026	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004031	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.03	0.00	0.00
Franklin	2265004035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004036	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Residential)	Lawn and Garden	0.02	0.00	0.00

Franklin	2265004041	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265004046	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265004051	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2265004055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Residential)	Lawn and Garden	0.33	0.00	0.01
Franklin	2265004056	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.07	0.00	0.00
Franklin	2265004066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265004071	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.20	0.00	0.00
Franklin	2265004075	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Residential)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265004076	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.01	0.00	0.00
Franklin	2265005010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
Franklin	2265005015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.00	0.00	0.00
Franklin	2265005020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Combines	Agricultural Equipment	0.00	0.00	0.00
Franklin	2265005025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2265005030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00

Franklin	2265005035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.02	0.00	0.00
Franklin	2265005040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.06	0.00	0.00
Franklin	2265005045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Swathers	Agricultural Equipment	0.01	0.00	0.00
Franklin	2265005055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.01	0.00	0.00
Franklin	2265005060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Franklin	2265006005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.16	0.00	0.00
Franklin	2265006010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.03	0.00	0.00
Franklin	2265006015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.01	0.00	0.00
Franklin	2265006025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Welders	Commercial Equipment	0.04	0.00	0.00
Franklin	2265006030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pressure Washers	Commercial Equipment	0.06	0.00	0.00
Franklin	2265006035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Franklin	2265007010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Shredders : 6 HP	Logging Equipment	0.00	0.00	0.00
Franklin	2265007015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
Franklin	2265010010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.02	0.00	0.00

Franklin	2267001060	Mobile Sources	LPG	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
Franklin	2267002003	Mobile Sources	LPG	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
Franklin	2267002015	Mobile Sources	LPG	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
Franklin	2267002021	Mobile Sources	LPG	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2267002024	Mobile Sources	LPG	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2267002030	Mobile Sources	LPG	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00
Franklin	2267002033	Mobile Sources	LPG	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.00	0.00	0.00
Franklin	2267002039	Mobile Sources	LPG	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
Franklin	2267002045	Mobile Sources	LPG	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
Franklin	2267002054	Mobile Sources	LPG	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2267002057	Mobile Sources	LPG	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
Franklin	2267002060	Mobile Sources	LPG	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
Franklin	2267002066	Mobile Sources	LPG	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.00	0.00	0.00
Franklin	2267002072	Mobile Sources	LPG	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.00	0.00	0.00
Franklin	2267002081	Mobile Sources	LPG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2267003010	Mobile Sources	LPG	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.00	0.00	0.00
Franklin	2267003020	Mobile Sources	LPG	Industrial Equipment	Forklifts	Industrial Equipment	0.08	0.01	0.00
Franklin	2267003030	Mobile Sources	LPG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Franklin	2267003040	Mobile Sources	LPG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2267003050	Mobile Sources	LPG	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00

Franklin	2267003070	Mobile Sources	LPG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Franklin	2267004066	Mobile Sources	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2267005055	Mobile Sources	LPG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
Franklin	2267005060	Mobile Sources	LPG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Franklin	2267006005	Mobile Sources	LPG	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Franklin	2267006010	Mobile Sources	LPG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
Franklin	2267006015	Mobile Sources	LPG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Franklin	2267006025	Mobile Sources	LPG	Commercial Equipment	Welders	Commercial Equipment	0.00	0.00	0.00
Franklin	2267006030	Mobile Sources	LPG	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
Franklin	2267006035	Mobile Sources	LPG	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Franklin	2268002081	Mobile Sources	CNG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2268003020	Mobile Sources	CNG	Industrial Equipment	Forklifts	Industrial Equipment	0.01	0.00	0.00
Franklin	2268003030	Mobile Sources	CNG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Franklin	2268003040	Mobile Sources	CNG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2268003060	Mobile Sources	CNG	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
Franklin	2268003070	Mobile Sources	CNG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Franklin	2268005055	Mobile Sources	CNG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
Franklin	2268005060	Mobile Sources	CNG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Franklin	2268006005	Mobile Sources	CNG	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Franklin	2268006010	Mobile Sources	CNG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00

Franklin	2268006015	Mobile Sources	CNG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Franklin	2268006020	Mobile Sources	CNG	Commercial Equipment	Gas Compressors	Commercial Equipment	0.00	0.00	0.00
Franklin	2268010010	Mobile Sources	CNG	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2270001060	Mobile Sources	Off-highway Vehicle Diesel	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
Franklin	2270002003	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002006	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002009	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
Franklin	2270002015	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002018	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Scrapers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002021	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2270002024	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2270002027	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Franklin	2270002030	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002033	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.00	0.00	0.00
Franklin	2270002036	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Excavators	Construction and Mining	0.00	0.00	0.00
Franklin	2270002039	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
Franklin	2270002042	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.00	0.00	0.00
Franklin	2270002045	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
Franklin	2270002048	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Graders	Construction and Mining	0.00	0.00	0.00
Franklin	2270002051	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Trucks	Construction and Mining	0.00	0.00	0.00

Franklin	2270002054	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2270002057	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
Franklin	2270002060	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.01	0.00
Franklin	2270002066	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.01	0.01	0.00
Franklin	2270002069	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crawler Tractor/Dozers	Construction and Mining	0.00	0.01	0.00
Franklin	2270002072	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.01	0.01	0.00
Franklin	2270002075	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Tractors	Construction and Mining	0.00	0.00	0.00
Franklin	2270002078	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.00	0.00	0.00
Franklin	2270002081	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Franklin	2270003010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.00	0.00	0.00
Franklin	2270003020	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts	Industrial Equipment	0.00	0.01	0.00
Franklin	2270003030	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Franklin	2270003040	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2270003050	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2270003060	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.01	0.00
Franklin	2270003070	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Franklin	2270004031	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270004036	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270004046	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270004056	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.00	0.00	0.00

Franklin	2270004066	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270004071	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270004076	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
Franklin	2270005010	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005015	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.09	0.21	0.02
Franklin	2270005020	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Combines	Agricultural Equipment	0.01	0.02	0.00
Franklin	2270005025	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005030	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005035	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005040	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005045	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Swathers	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005055	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270005060	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Franklin	2270006005	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Franklin	2270006010	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
Franklin	2270006015	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Franklin	2270006025	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Welders	Commercial Equipment	0.00	0.00	0.00
Franklin	2270006030	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
Franklin	2270006035	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Franklin	2270007015	Mobile Sources	Off-highway Vehicle Diesel	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00

Franklin	2270010010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.00	0.00
Franklin	2282005010	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Outboard	Pleasure Marine	0.09	0.00	0.04
Franklin	2282005015	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Personal Water Craft	Pleasure Marine	0.04	0.00	0.01
Franklin	2282010005	Mobile Sources	Pleasure Craft	Gasoline 4-Stroke	Inboard/Stern Drive	Pleasure Marine	0.06	0.00	0.01
Franklin	2282020005	Mobile Sources	Pleasure Craft	Diesel	Inboard/Stern Drive	Pleasure Marine	0.00	0.00	0.00
Franklin	2282020010	Mobile Sources	Pleasure Craft	Diesel	Outboard	Pleasure Marine	0.00	0.00	0.00
Franklin	2285002015	Mobile Sources	Railroad Equipment	Diesel	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
Franklin	2285004015	Mobile Sources	Railroad Equipment	Gasoline, 4-Stroke	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
Franklin	2285006015	Mobile Sources	Railroad Equipment	LPG	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
<b>Franklin County (Boles Township) Total</b>							<b>2.37</b>	<b>0.39</b>	<b>0.24</b>
Jefferson	2260001010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.12	0.00	0.12
Jefferson	2260001030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.07	0.00	0.03
Jefferson	2260001060	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.05	0.00	0.00
Jefferson	2260002006	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.03	0.00	0.01
Jefferson	2260002009	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
Jefferson	2260002021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2260002027	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Jefferson	2260002039	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.07	0.00	0.02

Jefferson	2260002054	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2260003030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Jefferson	2260003040	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2260004015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.01	0.00	0.00
Jefferson	2260004016	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.04	0.00	0.01
Jefferson	2260004020	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Residential)	Lawn and Garden	0.04	0.00	0.01
Jefferson	2260004021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)	Lawn and Garden	0.37	0.00	0.11
Jefferson	2260004025	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.09	0.00	0.03
Jefferson	2260004026	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.41	0.00	0.11
Jefferson	2260004030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.06	0.00	0.02
Jefferson	2260004031	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.46	0.00	0.11
Jefferson	2260004035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2260004036	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2260004071	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00

Jefferson	2260005035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2260006005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Jefferson	2260006010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.02	0.00	0.01
Jefferson	2260006015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Jefferson	2260006035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Jefferson	2260007005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Logging Equipment	Chain Saws : 6 HP	Logging Equipment	0.00	0.00	0.00
Jefferson	2265001010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.05	0.00	0.01
Jefferson	2265001030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.57	0.01	0.06
Jefferson	2265001050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Golf Carts	Recreational Vehicles	0.70	0.00	0.01
Jefferson	2265001060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.06	0.00	0.00
Jefferson	2265002003	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Pavers	Construction and Mining	0.01	0.00	0.00
Jefferson	2265002006	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
Jefferson	2265002009	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.02	0.00	0.00
Jefferson	2265002015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rollers	Construction and Mining	0.03	0.00	0.00

Jefferson	2265002021	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.05	0.00	0.00
Jefferson	2265002024	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.02	0.00	0.00
Jefferson	2265002027	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Jefferson	2265002030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Trenchers	Construction and Mining	0.04	0.00	0.00
Jefferson	2265002033	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.01	0.00	0.00
Jefferson	2265002039	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.10	0.00	0.00
Jefferson	2265002042	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.05	0.00	0.00
Jefferson	2265002045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
Jefferson	2265002054	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.01	0.00	0.00
Jefferson	2265002057	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
Jefferson	2265002060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
Jefferson	2265002066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.03	0.00	0.00
Jefferson	2265002072	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.02	0.00	0.00
Jefferson	2265002078	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.01	0.00	0.00

Jefferson	2265002081	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2265003010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.04	0.00	0.00
Jefferson	2265003020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Forklifts	Industrial Equipment	0.02	0.00	0.00
Jefferson	2265003030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.03	0.00	0.00
Jefferson	2265003040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.09	0.00	0.00
Jefferson	2265003050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2265003060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
Jefferson	2265003070	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Jefferson	2265004010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Residential)	Lawn and Garden	0.78	0.01	0.07
Jefferson	2265004011	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Commercial)	Lawn and Garden	0.89	0.01	0.05
Jefferson	2265004015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.07	0.00	0.01
Jefferson	2265004016	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.50	0.01	0.04
Jefferson	2265004025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2265004026	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.03	0.00	0.00

Jefferson	2265004030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.01	0.00	0.00
Jefferson	2265004031	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	1.11	0.01	0.03
Jefferson	2265004035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2265004036	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2265004040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Residential)	Lawn and Garden	0.24	0.00	0.01
Jefferson	2265004041	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)	Lawn and Garden	0.17	0.00	0.00
Jefferson	2265004046	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.20	0.00	0.01
Jefferson	2265004051	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)	Lawn and Garden	0.06	0.00	0.00
Jefferson	2265004055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Residential)	Lawn and Garden	3.26	0.02	0.09
Jefferson	2265004056	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	2.28	0.01	0.05
Jefferson	2265004066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.24	0.00	0.00
Jefferson	2265004071	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	6.34	0.05	0.13
Jefferson	2265004075	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Residential)	Lawn and Garden	0.10	0.00	0.00
Jefferson	2265004076	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.19	0.00	0.01

Jefferson	2265005010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2265005015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2265005020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Combines	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2265005025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Balers	Agricultural Equipment	0.01	0.00	0.00
Jefferson	2265005030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2265005035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.03	0.00	0.00
Jefferson	2265005040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.10	0.00	0.00
Jefferson	2265005045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Swathers	Agricultural Equipment	0.01	0.00	0.00
Jefferson	2265005055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.02	0.00	0.00
Jefferson	2265005060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2265006005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.96	0.01	0.03
Jefferson	2265006010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.19	0.00	0.01
Jefferson	2265006015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.09	0.00	0.00
Jefferson	2265006025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Welders	Commercial Equipment	0.25	0.00	0.01

Jefferson	2265006030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pressure Washers	Commercial Equipment	0.38	0.00	0.01
Jefferson	2265006035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.02	0.00	0.00
Jefferson	2265007010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Shredders : 6 HP	Logging Equipment	0.00	0.00	0.00
Jefferson	2265007015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
Jefferson	2265010010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.13	0.00	0.00
Jefferson	2267001060	Mobile Sources	LPG	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
Jefferson	2267002003	Mobile Sources	LPG	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002015	Mobile Sources	LPG	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002021	Mobile Sources	LPG	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002024	Mobile Sources	LPG	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002030	Mobile Sources	LPG	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002033	Mobile Sources	LPG	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002039	Mobile Sources	LPG	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002045	Mobile Sources	LPG	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002054	Mobile Sources	LPG	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002057	Mobile Sources	LPG	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002060	Mobile Sources	LPG	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002066	Mobile Sources	LPG	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.00	0.00	0.00

Jefferson	2267002072	Mobile Sources	LPG	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.00	0.00	0.00
Jefferson	2267002081	Mobile Sources	LPG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2267003010	Mobile Sources	LPG	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.01	0.00	0.00
Jefferson	2267003020	Mobile Sources	LPG	Industrial Equipment	Forklifts	Industrial Equipment	0.18	0.03	0.00
Jefferson	2267003030	Mobile Sources	LPG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
Jefferson	2267003040	Mobile Sources	LPG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2267003050	Mobile Sources	LPG	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2267003070	Mobile Sources	LPG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Jefferson	2267004066	Mobile Sources	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.01	0.00	0.00
Jefferson	2267005055	Mobile Sources	LPG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2267005060	Mobile Sources	LPG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2267006005	Mobile Sources	LPG	Commercial Equipment	Generator Sets	Commercial Equipment	0.01	0.00	0.00
Jefferson	2267006010	Mobile Sources	LPG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
Jefferson	2267006015	Mobile Sources	LPG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Jefferson	2267006025	Mobile Sources	LPG	Commercial Equipment	Welders	Commercial Equipment	0.00	0.00	0.00
Jefferson	2267006030	Mobile Sources	LPG	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
Jefferson	2267006035	Mobile Sources	LPG	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Jefferson	2268002081	Mobile Sources	CNG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2268003020	Mobile Sources	CNG	Industrial Equipment	Forklifts	Industrial Equipment	0.01	0.00	0.00
Jefferson	2268003030	Mobile Sources	CNG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00

Jefferson	2268003040	Mobile Sources	CNG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2268003060	Mobile Sources	CNG	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
Jefferson	2268003070	Mobile Sources	CNG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
Jefferson	2268005055	Mobile Sources	CNG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2268005060	Mobile Sources	CNG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2268006005	Mobile Sources	CNG	Commercial Equipment	Generator Sets	Commercial Equipment	0.00	0.00	0.00
Jefferson	2268006010	Mobile Sources	CNG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
Jefferson	2268006015	Mobile Sources	CNG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
Jefferson	2268006020	Mobile Sources	CNG	Commercial Equipment	Gas Compressors	Commercial Equipment	0.00	0.00	0.00
Jefferson	2268010010	Mobile Sources	CNG	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2270001060	Mobile Sources	Off-highway Vehicle Diesel	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
Jefferson	2270002003	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.01	0.00
Jefferson	2270002006	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002009	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002015	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rollers	Construction and Mining	0.01	0.02	0.00
Jefferson	2270002018	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Scrapers	Construction and Mining	0.01	0.02	0.00
Jefferson	2270002021	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002024	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002027	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002030	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.01	0.00

Jefferson	2270002033	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.01	0.02	0.00
Jefferson	2270002036	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Excavators	Construction and Mining	0.02	0.04	0.00
Jefferson	2270002039	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002042	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002045	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.02	0.00
Jefferson	2270002048	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Graders	Construction and Mining	0.00	0.01	0.00
Jefferson	2270002051	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Trucks	Construction and Mining	0.01	0.05	0.00
Jefferson	2270002054	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002057	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.01	0.02	0.00
Jefferson	2270002060	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.03	0.08	0.01
Jefferson	2270002066	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.08	0.09	0.02
Jefferson	2270002069	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crawler Tractor/Dozers	Construction and Mining	0.02	0.06	0.00
Jefferson	2270002072	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.08	0.07	0.02
Jefferson	2270002075	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Tractors	Construction and Mining	0.00	0.01	0.00
Jefferson	2270002078	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.00	0.00	0.00
Jefferson	2270002081	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.01	0.01	0.00
Jefferson	2270003010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.00	0.00	0.00
Jefferson	2270003020	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts	Industrial Equipment	0.00	0.01	0.00
Jefferson	2270003030	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.01	0.00
Jefferson	2270003040	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.01	0.00

Jefferson	2270003050	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
Jefferson	2270003060	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.02	0.05	0.00
Jefferson	2270003070	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.01	0.00
Jefferson	2270004031	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2270004036	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2270004046	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.01	0.03	0.00
Jefferson	2270004056	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.00	0.01	0.00
Jefferson	2270004066	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.02	0.04	0.00
Jefferson	2270004071	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2270004076	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
Jefferson	2270005010	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005015	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.15	0.35	0.03
Jefferson	2270005020	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Combines	Agricultural Equipment	0.01	0.04	0.00
Jefferson	2270005025	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005030	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005035	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005040	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005045	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Swathers	Agricultural Equipment	0.00	0.00	0.00
Jefferson	2270005055	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.01	0.00
Jefferson	2270005060	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00

Jefferson	2270006005	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets	Commercial Equipment	0.01	0.02	0.00
Jefferson	2270006010	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.01	0.00
Jefferson	2270006015	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.01	0.00
Jefferson	2270006025	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Welders	Commercial Equipment	0.01	0.01	0.00
Jefferson	2270006030	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
Jefferson	2270006035	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
Jefferson	2270007015	Mobile Sources	Off-highway Vehicle Diesel	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
Jefferson	2270010010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.01	0.00
Jefferson	2282005010	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Outboard	Pleasure Marine	0.43	0.02	0.18
Jefferson	2282005015	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Personal Water Craft	Pleasure Marine	0.21	0.01	0.03
Jefferson	2282010005	Mobile Sources	Pleasure Craft	Gasoline 4-Stroke	Inboard/Sterndrive	Pleasure Marine	0.28	0.02	0.03
Jefferson	2282020005	Mobile Sources	Pleasure Craft	Diesel	Inboard/Sterndrive	Pleasure Marine	0.00	0.02	0.00
Jefferson	2282020010	Mobile Sources	Pleasure Craft	Diesel	Outboard	Pleasure Marine	0.00	0.00	0.00
Jefferson	2285002015	Mobile Sources	Railroad Equipment	Diesel	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
Jefferson	2285004015	Mobile Sources	Railroad Equipment	Gasoline, 4-Stroke	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
Jefferson	2285006015	Mobile Sources	Railroad Equipment	LPG	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
<b>Jefferson County Total</b>							<b>24.23</b>	<b>1.47</b>	<b>1.61</b>
St. Charles	2260001010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.04	0.00	0.04
St. Charles	2260001030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.02	0.00	0.01
St. Charles	2260001060	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.02	0.00	0.00
St. Charles	2260002006	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.07	0.00	0.02

St. Charles	2260002009	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
St. Charles	2260002021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2260002027	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
St. Charles	2260002039	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.17	0.00	0.04
St. Charles	2260002054	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2260003030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Charles	2260003040	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2260004015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.01	0.00	0.00
St. Charles	2260004016	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.10	0.00	0.02
St. Charles	2260004020	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Residential)	Lawn and Garden	0.05	0.00	0.02
St. Charles	2260004021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)	Lawn and Garden	0.91	0.01	0.26
St. Charles	2260004025	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.13	0.00	0.04
St. Charles	2260004026	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	1.00	0.01	0.26
St. Charles	2260004030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.09	0.00	0.02

St. Charles	2260004031	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	1.11	0.01	0.26
St. Charles	2260004035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2260004036	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2260004071	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2260005035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2260006005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.01	0.00	0.00
St. Charles	2260006010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.07	0.00	0.02
St. Charles	2260006015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Charles	2260006035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Charles	2260007005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Logging Equipment	Chain Saws : 6 HP	Logging Equipment	0.00	0.00	0.00
St. Charles	2265001010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.02	0.00	0.00
St. Charles	2265001030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.19	0.00	0.02
St. Charles	2265001050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Golf Carts	Recreational Vehicles	1.40	0.01	0.03
St. Charles	2265001060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.02	0.00	0.00

St. Charles	2265002003	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Pavers	Construction and Mining	0.04	0.00	0.00
St. Charles	2265002006	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
St. Charles	2265002009	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.06	0.00	0.00
St. Charles	2265002015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rollers	Construction and Mining	0.06	0.00	0.00
St. Charles	2265002021	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.13	0.00	0.00
St. Charles	2265002024	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.06	0.00	0.00
St. Charles	2265002027	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
St. Charles	2265002030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Trenchers	Construction and Mining	0.10	0.00	0.00
St. Charles	2265002033	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.03	0.00	0.00
St. Charles	2265002039	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.26	0.00	0.00
St. Charles	2265002042	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.12	0.00	0.00
St. Charles	2265002045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cranes	Construction and Mining	0.01	0.00	0.00
St. Charles	2265002054	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.02	0.00	0.00
St. Charles	2265002057	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00

St. Charles	2265002060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
St. Charles	2265002066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.09	0.00	0.00
St. Charles	2265002072	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.04	0.00	0.00
St. Charles	2265002078	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.02	0.00	0.00
St. Charles	2265002081	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.01	0.00	0.00
St. Charles	2265003010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.12	0.00	0.00
St. Charles	2265003020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Forklifts	Industrial Equipment	0.07	0.01	0.00
St. Charles	2265003030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.09	0.00	0.00
St. Charles	2265003040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.28	0.00	0.01
St. Charles	2265003050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.01	0.00	0.00
St. Charles	2265003060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.01	0.00	0.00
St. Charles	2265003070	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.01	0.00	0.00
St. Charles	2265004010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Residential)	Lawn and Garden	1.13	0.01	0.10
St. Charles	2265004011	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Commercial)	Lawn and Garden	2.15	0.02	0.13

St. Charles	2265004015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.10	0.00	0.01
St. Charles	2265004016	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	1.21	0.01	0.09
St. Charles	2265004025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.01	0.00	0.00
St. Charles	2265004026	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.06	0.00	0.00
St. Charles	2265004030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.01	0.00	0.00
St. Charles	2265004031	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	2.69	0.02	0.08
St. Charles	2265004035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2265004036	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2265004040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Residential)	Lawn and Garden	0.35	0.00	0.01
St. Charles	2265004041	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)	Lawn and Garden	0.41	0.00	0.01
St. Charles	2265004046	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.48	0.00	0.01
St. Charles	2265004051	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)	Lawn and Garden	0.14	0.00	0.01
St. Charles	2265004055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Residential)	Lawn and Garden	4.70	0.03	0.14
St. Charles	2265004056	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	5.55	0.04	0.11

St. Charles	2265004066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.57	0.01	0.01
St. Charles	2265004071	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	15.39	0.11	0.32
St. Charles	2265004075	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Residential)	Lawn and Garden	0.14	0.00	0.01
St. Charles	2265004076	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.47	0.00	0.02
St. Charles	2265005010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.01	0.00	0.00
St. Charles	2265005015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.02	0.00	0.00
St. Charles	2265005020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Combines	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2265005025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Balers	Agricultural Equipment	0.02	0.00	0.00
St. Charles	2265005030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.01	0.00	0.00
St. Charles	2265005035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.10	0.00	0.00
St. Charles	2265005040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.34	0.00	0.01
St. Charles	2265005045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Swathers	Agricultural Equipment	0.03	0.00	0.00
St. Charles	2265005055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.05	0.00	0.00
St. Charles	2265005060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.01	0.00	0.00

St. Charles	2265006005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	2.58	0.02	0.07
St. Charles	2265006010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.51	0.01	0.02
St. Charles	2265006015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.24	0.00	0.01
St. Charles	2265006025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Welders	Commercial Equipment	0.66	0.01	0.02
St. Charles	2265006030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pressure Washers	Commercial Equipment	1.02	0.01	0.03
St. Charles	2265006035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.05	0.00	0.00
St. Charles	2265007010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Shredders : 6 HP	Logging Equipment	0.00	0.00	0.00
St. Charles	2265007015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
St. Charles	2265008005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.00	0.00	0.00
St. Charles	2265010010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.13	0.00	0.00
St. Charles	2267001060	Mobile Sources	LPG	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
St. Charles	2267002003	Mobile Sources	LPG	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002015	Mobile Sources	LPG	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002021	Mobile Sources	LPG	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002024	Mobile Sources	LPG	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002030	Mobile Sources	LPG	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00

St. Charles	2267002033	Mobile Sources	LPG	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002039	Mobile Sources	LPG	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002045	Mobile Sources	LPG	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002054	Mobile Sources	LPG	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002057	Mobile Sources	LPG	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002060	Mobile Sources	LPG	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002066	Mobile Sources	LPG	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.00	0.00	0.00
St. Charles	2267002072	Mobile Sources	LPG	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.01	0.00	0.00
St. Charles	2267002081	Mobile Sources	LPG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2267003010	Mobile Sources	LPG	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.02	0.00	0.00
St. Charles	2267003020	Mobile Sources	LPG	Industrial Equipment	Forklifts	Industrial Equipment	0.59	0.10	0.01
St. Charles	2267003030	Mobile Sources	LPG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Charles	2267003040	Mobile Sources	LPG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2267003050	Mobile Sources	LPG	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2267003070	Mobile Sources	LPG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
St. Charles	2267004066	Mobile Sources	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.01	0.00	0.00
St. Charles	2267005055	Mobile Sources	LPG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2267005060	Mobile Sources	LPG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2267006005	Mobile Sources	LPG	Commercial Equipment	Generator Sets	Commercial Equipment	0.03	0.01	0.00
St. Charles	2267006010	Mobile Sources	LPG	Commercial Equipment	Pumps	Commercial Equipment	0.01	0.00	0.00

St. Charles	2267006015	Mobile Sources	LPG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Charles	2267006025	Mobile Sources	LPG	Commercial Equipment	Welders	Commercial Equipment	0.01	0.00	0.00
St. Charles	2267006030	Mobile Sources	LPG	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
St. Charles	2267006035	Mobile Sources	LPG	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Charles	2267008005	Mobile Sources	LPG	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.00	0.00	0.00
St. Charles	2268002081	Mobile Sources	CNG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2268003020	Mobile Sources	CNG	Industrial Equipment	Forklifts	Industrial Equipment	0.05	0.01	0.00
St. Charles	2268003030	Mobile Sources	CNG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Charles	2268003040	Mobile Sources	CNG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2268003060	Mobile Sources	CNG	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
St. Charles	2268003070	Mobile Sources	CNG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
St. Charles	2268005055	Mobile Sources	CNG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2268005060	Mobile Sources	CNG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.01	0.00	0.00
St. Charles	2268006005	Mobile Sources	CNG	Commercial Equipment	Generator Sets	Commercial Equipment	0.01	0.00	0.00
St. Charles	2268006010	Mobile Sources	CNG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
St. Charles	2268006015	Mobile Sources	CNG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Charles	2268006020	Mobile Sources	CNG	Commercial Equipment	Gas Compressors	Commercial Equipment	0.01	0.00	0.00
St. Charles	2268010010	Mobile Sources	CNG	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2270001060	Mobile Sources	Off-highway Vehicle Diesel	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
St. Charles	2270002003	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Pavers	Construction and Mining	0.01	0.01	0.00

St. Charles	2270002006	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002009	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002015	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rollers	Construction and Mining	0.02	0.04	0.00
St. Charles	2270002018	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Scrapers	Construction and Mining	0.02	0.04	0.00
St. Charles	2270002021	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002024	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002027	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.01	0.00
St. Charles	2270002030	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Trenchers	Construction and Mining	0.01	0.02	0.00
St. Charles	2270002033	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.01	0.05	0.00
St. Charles	2270002036	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Excavators	Construction and Mining	0.04	0.09	0.01
St. Charles	2270002039	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002042	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002045	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cranes	Construction and Mining	0.01	0.04	0.00
St. Charles	2270002048	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Graders	Construction and Mining	0.01	0.02	0.00
St. Charles	2270002051	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Trucks	Construction and Mining	0.03	0.12	0.01
St. Charles	2270002054	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.01	0.00
St. Charles	2270002057	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.03	0.05	0.00
St. Charles	2270002060	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.08	0.21	0.01
St. Charles	2270002066	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.19	0.22	0.05
St. Charles	2270002069	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crawler Tractor/Dozers	Construction and Mining	0.06	0.14	0.01

St. Charles	2270002072	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.20	0.18	0.05
St. Charles	2270002075	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Tractors	Construction and Mining	0.01	0.02	0.00
St. Charles	2270002078	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.00	0.00	0.00
St. Charles	2270002081	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.01	0.03	0.00
St. Charles	2270003010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.01	0.01	0.00
St. Charles	2270003020	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts	Industrial Equipment	0.02	0.04	0.00
St. Charles	2270003030	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.02	0.00
St. Charles	2270003040	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.01	0.03	0.00
St. Charles	2270003050	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
St. Charles	2270003060	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.02	0.08	0.00
St. Charles	2270003070	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.01	0.02	0.00
St. Charles	2270004031	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2270004036	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2270004046	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.03	0.07	0.01
St. Charles	2270004056	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.01	0.01	0.00
St. Charles	2270004066	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.04	0.10	0.01
St. Charles	2270004071	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.01	0.00
St. Charles	2270004076	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Charles	2270005010	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2270005015	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.50	1.16	0.10

St. Charles	2270005020	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Combines	Agricultural Equipment	0.04	0.12	0.01
St. Charles	2270005025	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2270005030	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2270005035	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.01	0.00
St. Charles	2270005040	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.00	0.00	0.00
St. Charles	2270005045	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Swathers	Agricultural Equipment	0.01	0.01	0.00
St. Charles	2270005055	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.01	0.02	0.00
St. Charles	2270005060	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.01	0.01	0.00
St. Charles	2270006005	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets	Commercial Equipment	0.03	0.06	0.01
St. Charles	2270006010	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pumps	Commercial Equipment	0.01	0.01	0.00
St. Charles	2270006015	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors	Commercial Equipment	0.01	0.03	0.00
St. Charles	2270006025	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Welders	Commercial Equipment	0.02	0.02	0.00
St. Charles	2270006030	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
St. Charles	2270006035	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Charles	2270007015	Mobile Sources	Off-highway Vehicle Diesel	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
St. Charles	2270008005	Mobile Sources	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.00	0.00	0.00
St. Charles	2270010010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.00	0.01	0.00
St. Charles	2282005010	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Outboard	Pleasure Marine	1.89	0.10	0.77
St. Charles	2282005015	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Personal Water Craft	Pleasure Marine	0.91	0.05	0.12
St. Charles	2282010005	Mobile Sources	Pleasure Craft	Gasoline 4-Stroke	Inboard/Sterndrive	Pleasure Marine	1.23	0.10	0.12
St. Charles	2282020005	Mobile Sources	Pleasure Craft	Diesel	Inboard/Sterndrive	Pleasure Marine	0.02	0.09	0.00
St. Charles	2282020010	Mobile Sources	Pleasure Craft	Diesel	Outboard	Pleasure Marine	0.00	0.00	0.00

St. Charles	2285002015	Mobile Sources	Railroad Equipment	Diesel	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
St. Charles	2285004015	Mobile Sources	Railroad Equipment	Gasoline, 4-Stroke	Railway Maintenance	Railway Maintenance	0.01	0.00	0.00
St. Charles	2285006015	Mobile Sources	Railroad Equipment	LPG	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
<b>St. Charles County Total</b>							<b>54.79</b>	<b>4.06</b>	<b>3.70</b>
St. Louis	2260001010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.29	0.00	0.29
St. Louis	2260001030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	0.16	0.00	0.08
St. Louis	2260001060	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.12	0.00	0.00
St. Louis	2260002006	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.16	0.00	0.04
St. Louis	2260002009	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.01	0.00	0.00
St. Louis	2260002021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.01	0.00	0.00
St. Louis	2260002027	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.00	0.00	0.00
St. Louis	2260002039	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.42	0.00	0.10
St. Louis	2260002054	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
St. Louis	2260003030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.00	0.00
St. Louis	2260003040	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00

St. Louis	2260004015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.03	0.00	0.01
St. Louis	2260004016	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.66	0.01	0.16
St. Louis	2260004020	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Residential)	Lawn and Garden	0.20	0.00	0.08
St. Louis	2260004021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)	Lawn and Garden	6.12	0.04	1.72
St. Louis	2260004025	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.50	0.01	0.15
St. Louis	2260004026	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	6.71	0.07	1.72
St. Louis	2260004030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.34	0.00	0.09
St. Louis	2260004031	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	7.48	0.06	1.72
St. Louis	2260004035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.01
St. Louis	2260004036	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis	2260004071	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis	2260005035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2260006005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.06	0.00	0.02
St. Louis	2260006010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.38	0.00	0.12

St. Louis	2260006015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Louis	2260006035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Louis	2260007005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Logging Equipment	Chain Saws : 6 HP	Logging Equipment	0.00	0.00	0.00
St. Louis	2265001010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Motorcycles: Off-road	Recreational Vehicles	0.12	0.00	0.01
St. Louis	2265001030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	All Terrain Vehicles	Recreational Vehicles	1.34	0.01	0.13
St. Louis	2265001050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Golf Carts	Recreational Vehicles	2.80	0.02	0.06
St. Louis	2265001060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.14	0.00	0.01
St. Louis	2265002003	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Pavers	Construction and Mining	0.09	0.00	0.00
St. Louis	2265002006	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
St. Louis	2265002009	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.15	0.00	0.00
St. Louis	2265002015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rollers	Construction and Mining	0.15	0.00	0.00
St. Louis	2265002021	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.33	0.00	0.01
St. Louis	2265002024	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.14	0.00	0.00
St. Louis	2265002027	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.01	0.00	0.00

St. Louis	2265002030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Trenchers	Construction and Mining	0.25	0.00	0.01
St. Louis	2265002033	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.08	0.00	0.00
St. Louis	2265002039	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.62	0.00	0.01
St. Louis	2265002042	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.30	0.00	0.01
St. Louis	2265002045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Cranes	Construction and Mining	0.01	0.00	0.00
St. Louis	2265002054	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.04	0.00	0.00
St. Louis	2265002057	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.01	0.00	0.00
St. Louis	2265002060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.01	0.00	0.00
St. Louis	2265002066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.21	0.00	0.00
St. Louis	2265002072	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.11	0.00	0.00
St. Louis	2265002078	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.05	0.00	0.00
St. Louis	2265002081	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.02	0.00	0.00
St. Louis	2265003010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.46	0.01	0.01
St. Louis	2265003020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Forklifts	Industrial Equipment	0.28	0.02	0.01

St. Louis	2265003030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.34	0.00	0.01
St. Louis	2265003040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	1.04	0.01	0.03
St. Louis	2265003050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.03	0.00	0.00
St. Louis	2265003060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.02	0.00	0.00
St. Louis	2265003070	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.02	0.00	0.00
St. Louis	2265004010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Residential)	Lawn and Garden	4.27	0.04	0.37
St. Louis	2265004011	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Commercial)	Lawn and Garden	14.52	0.15	0.89
St. Louis	2265004015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.37	0.00	0.03
St. Louis	2265004016	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	8.18	0.08	0.58
St. Louis	2265004025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.02	0.00	0.00
St. Louis	2265004026	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.42	0.00	0.02
St. Louis	2265004030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.04	0.00	0.00
St. Louis	2265004031	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	18.14	0.15	0.56
St. Louis	2265004035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.01

St. Louis	2265004036	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.01
St. Louis	2265004040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Residential)	Lawn and Garden	1.32	0.01	0.05
St. Louis	2265004041	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)	Lawn and Garden	2.75	0.02	0.06
St. Louis	2265004046	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	3.26	0.03	0.08
St. Louis	2265004051	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)	Lawn and Garden	0.95	0.01	0.07
St. Louis	2265004055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Residential)	Lawn and Garden	17.70	0.12	0.51
St. Louis	2265004056	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	37.42	0.24	0.75
St. Louis	2265004066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	3.87	0.04	0.08
St. Louis	2265004071	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	103.84	0.76	2.18
St. Louis	2265004075	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Residential)	Lawn and Garden	0.53	0.01	0.02
St. Louis	2265004076	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	3.14	0.03	0.13
St. Louis	2265005010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265005015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265005020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Combines	Agricultural Equipment	0.00	0.00	0.00

St. Louis	2265005025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265005030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265005035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Sprayers	Agricultural Equipment	0.01	0.00	0.00
St. Louis	2265005040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.05	0.00	0.00
St. Louis	2265005045	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Swathers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265005055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.01	0.00	0.00
St. Louis	2265005060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2265006005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	14.89	0.11	0.41
St. Louis	2265006010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pumps	Commercial Equipment	2.92	0.03	0.09
St. Louis	2265006015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	1.40	0.01	0.04
St. Louis	2265006025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Welders	Commercial Equipment	3.83	0.03	0.09
St. Louis	2265006030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pressure Washers	Commercial Equipment	5.88	0.04	0.18
St. Louis	2265006035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.30	0.00	0.01
St. Louis	2265007010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Shredders : 6 HP	Logging Equipment	0.00	0.00	0.00

St. Louis	2265007015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
St. Louis	2265008005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.04	0.00	0.00
St. Louis	2265010010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.80	0.01	0.01
St. Louis	2267001060	Mobile Sources	LPG	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
St. Louis	2267002003	Mobile Sources	LPG	Construction and Mining Equipment	Pavers	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002015	Mobile Sources	LPG	Construction and Mining Equipment	Rollers	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002021	Mobile Sources	LPG	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002024	Mobile Sources	LPG	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002030	Mobile Sources	LPG	Construction and Mining Equipment	Trenchers	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002033	Mobile Sources	LPG	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.01	0.00	0.00
St. Louis	2267002039	Mobile Sources	LPG	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002045	Mobile Sources	LPG	Construction and Mining Equipment	Cranes	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002054	Mobile Sources	LPG	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002057	Mobile Sources	LPG	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002060	Mobile Sources	LPG	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002066	Mobile Sources	LPG	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.00	0.00	0.00
St. Louis	2267002072	Mobile Sources	LPG	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.01	0.00	0.00
St. Louis	2267002081	Mobile Sources	LPG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.01	0.00	0.00
St. Louis	2267003010	Mobile Sources	LPG	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.07	0.01	0.00

St. Louis	2267003020	Mobile Sources	LPG	Industrial Equipment	Forklifts	Industrial Equipment	2.20	0.36	0.06
St. Louis	2267003030	Mobile Sources	LPG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.00	0.00
St. Louis	2267003040	Mobile Sources	LPG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis	2267003050	Mobile Sources	LPG	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis	2267003070	Mobile Sources	LPG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.01	0.00	0.00
St. Louis	2267004066	Mobile Sources	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.09	0.02	0.00
St. Louis	2267005055	Mobile Sources	LPG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2267005060	Mobile Sources	LPG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2267006005	Mobile Sources	LPG	Commercial Equipment	Generator Sets	Commercial Equipment	0.20	0.06	0.01
St. Louis	2267006010	Mobile Sources	LPG	Commercial Equipment	Pumps	Commercial Equipment	0.03	0.01	0.00
St. Louis	2267006015	Mobile Sources	LPG	Commercial Equipment	Air Compressors	Commercial Equipment	0.02	0.00	0.00
St. Louis	2267006025	Mobile Sources	LPG	Commercial Equipment	Welders	Commercial Equipment	0.03	0.01	0.00
St. Louis	2267006030	Mobile Sources	LPG	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
St. Louis	2267006035	Mobile Sources	LPG	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Louis	2267008005	Mobile Sources	LPG	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.00	0.00	0.00
St. Louis	2268002081	Mobile Sources	CNG	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.00	0.00	0.00
St. Louis	2268003020	Mobile Sources	CNG	Industrial Equipment	Forklifts	Industrial Equipment	0.17	0.03	0.02
St. Louis	2268003030	Mobile Sources	CNG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Louis	2268003040	Mobile Sources	CNG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis	2268003060	Mobile Sources	CNG	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00

St. Louis	2268003070	Mobile Sources	CNG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
St. Louis	2268005055	Mobile Sources	CNG	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2268005060	Mobile Sources	CNG	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2268006005	Mobile Sources	CNG	Commercial Equipment	Generator Sets	Commercial Equipment	0.08	0.02	0.01
St. Louis	2268006010	Mobile Sources	CNG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
St. Louis	2268006015	Mobile Sources	CNG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Louis	2268006020	Mobile Sources	CNG	Commercial Equipment	Gas Compressors	Commercial Equipment	0.05	0.01	0.00
St. Louis	2268010010	Mobile Sources	CNG	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.02	0.00	0.00
St. Louis	2270001060	Mobile Sources	Off-highway Vehicle Diesel	Recreational Equipment	Specialty Vehicles/Carts	Recreational Vehicles	0.00	0.00	0.00
St. Louis	2270002003	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Pavers	Construction and Mining	0.01	0.03	0.00
St. Louis	2270002006	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tampers/Rammers	Construction and Mining	0.00	0.00	0.00
St. Louis	2270002009	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Plate Compactors	Construction and Mining	0.00	0.00	0.00
St. Louis	2270002015	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rollers	Construction and Mining	0.05	0.09	0.01
St. Louis	2270002018	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Scrapers	Construction and Mining	0.04	0.09	0.01
St. Louis	2270002021	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Paving Equipment	Construction and Mining	0.00	0.01	0.00
St. Louis	2270002024	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Surfacing Equipment	Construction and Mining	0.00	0.01	0.00
St. Louis	2270002027	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Signal Boards/Light Plants	Construction and Mining	0.01	0.02	0.00
St. Louis	2270002030	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Trenchers	Construction and Mining	0.03	0.06	0.00
St. Louis	2270002033	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Bore/Drill Rigs	Construction and Mining	0.04	0.12	0.01
St. Louis	2270002036	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Excavators	Construction and Mining	0.10	0.22	0.02

St. Louis	2270002039	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Concrete/Industrial Saws	Construction and Mining	0.00	0.00	0.00
St. Louis	2270002042	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cement and Mortar Mixers	Construction and Mining	0.00	0.00	0.00
St. Louis	2270002045	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Cranes	Construction and Mining	0.03	0.11	0.01
St. Louis	2270002048	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Graders	Construction and Mining	0.03	0.06	0.00
St. Louis	2270002051	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Trucks	Construction and Mining	0.08	0.29	0.01
St. Louis	2270002054	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crushing/Processing Equipment	Construction and Mining	0.01	0.02	0.00
St. Louis	2270002057	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rough Terrain Forklifts	Construction and Mining	0.08	0.13	0.01
St. Louis	2270002060	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Rubber Tire Loaders	Construction and Mining	0.20	0.50	0.03
St. Louis	2270002066	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Tractors/Loaders/Backhoes	Construction and Mining	0.47	0.54	0.11
St. Louis	2270002069	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Crawler Tractor/Dozers	Construction and Mining	0.14	0.33	0.02
St. Louis	2270002072	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Skid Steer Loaders	Construction and Mining	0.49	0.43	0.11
St. Louis	2270002075	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Off-highway Tractors	Construction and Mining	0.02	0.06	0.00
St. Louis	2270002078	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Dumpers/Tenders	Construction and Mining	0.00	0.00	0.00
St. Louis	2270002081	Mobile Sources	Off-highway Vehicle Diesel	Construction and Mining Equipment	Other Construction Equipment	Construction and Mining	0.03	0.08	0.00
St. Louis	2270003010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.03	0.03	0.01
St. Louis	2270003020	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts	Industrial Equipment	0.06	0.15	0.01
St. Louis	2270003030	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.02	0.08	0.00
St. Louis	2270003040	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.03	0.10	0.01
St. Louis	2270003050	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.01	0.00
St. Louis	2270003060	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.08	0.27	0.02

St. Louis	2270003070	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.03	0.07	0.00
St. Louis	2270004031	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis	2270004036	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis	2270004046	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.19	0.45	0.05
St. Louis	2270004056	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.04	0.09	0.01
St. Louis	2270004066	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.25	0.69	0.06
St. Louis	2270004071	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.02	0.05	0.00
St. Louis	2270004076	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis	2270005010	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	2-Wheel Tractors	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005015	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Tractors	Agricultural Equipment	0.07	0.16	0.01
St. Louis	2270005020	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Combines	Agricultural Equipment	0.01	0.02	0.00
St. Louis	2270005025	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Balers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005030	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Agricultural Mowers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005035	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Sprayers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005040	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Tillers : 6 HP	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005045	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Swathers	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005055	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Other Agricultural Equipment	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270005060	Mobile Sources	Off-highway Vehicle Diesel	Agricultural Equipment	Irrigation Sets	Agricultural Equipment	0.00	0.00	0.00
St. Louis	2270006005	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets	Commercial Equipment	0.15	0.34	0.04
St. Louis	2270006010	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pumps	Commercial Equipment	0.04	0.08	0.01

St. Louis	2270006015	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors	Commercial Equipment	0.06	0.16	0.01
St. Louis	2270006025	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Welders	Commercial Equipment	0.11	0.11	0.02
St. Louis	2270006030	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.01	0.00
St. Louis	2270006035	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.01	0.00
St. Louis	2270007015	Mobile Sources	Off-highway Vehicle Diesel	Logging Equipment	Forest Eqp - Feller/Bunch/Skidder	Logging Equipment	0.00	0.00	0.00
St. Louis	2270008005	Mobile Sources	Off-highway Vehicle Diesel	Airport Ground Support Equipment	Airport Ground Support Equipment	Airport Ground Support Equipment	0.04	0.08	0.01
St. Louis	2270010010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Oil Field Equipment	Industrial Equipment	0.01	0.04	0.00
St. Louis	2282005010	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Outboard	Pleasure Marine	0.93	0.05	0.38
St. Louis	2282005015	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Personal Water Craft	Pleasure Marine	0.45	0.02	0.06
St. Louis	2282010005	Mobile Sources	Pleasure Craft	Gasoline 4-Stroke	Inboard/Sterndrive	Pleasure Marine	0.61	0.05	0.06
St. Louis	2282020005	Mobile Sources	Pleasure Craft	Diesel	Inboard/Sterndrive	Pleasure Marine	0.01	0.05	0.00
St. Louis	2282020010	Mobile Sources	Pleasure Craft	Diesel	Outboard	Pleasure Marine	0.00	0.00	0.00
St. Louis	2285002015	Mobile Sources	Railroad Equipment	Diesel	Railway Maintenance	Railway Maintenance	0.00	0.01	0.00
St. Louis	2285004015	Mobile Sources	Railroad Equipment	Gasoline, 4-Stroke	Railway Maintenance	Railway Maintenance	0.01	0.00	0.00
St. Louis	2285006015	Mobile Sources	Railroad Equipment	LPG	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
<b>St. Louis County Total</b>							<b>291.90</b>	<b>9.17</b>	<b>15.13</b>
St. Louis City	2260003030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2260003040	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2260004015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.01	0.00	0.00
St. Louis City	2260004016	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.04	0.00	0.01

St. Louis City	2260004020	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Residential)	Lawn and Garden	0.08	0.00	0.03
St. Louis City	2260004021	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Chain Saws < 6 HP (Commercial)	Lawn and Garden	0.33	0.00	0.09
St. Louis City	2260004025	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.21	0.00	0.06
St. Louis City	2260004026	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.36	0.00	0.09
St. Louis City	2260004030	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.14	0.00	0.04
St. Louis City	2260004031	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.40	0.00	0.09
St. Louis City	2260004035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2260004036	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2260004071	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2260006005	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	0.02	0.00	0.01
St. Louis City	2260006010	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Pumps	Commercial Equipment	0.13	0.00	0.04
St. Louis City	2260006015	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2260006035	Mobile Sources	Off-highway Vehicle Gasoline, 2-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2265001050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Recreational Equipment	Golf Carts	Recreational Vehicles	0.35	0.00	0.01

St. Louis City	2265003010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.20	0.01	0.01
St. Louis City	2265003020	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Forklifts	Industrial Equipment	0.12	0.01	0.00
St. Louis City	2265003030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.15	0.00	0.00
St. Louis City	2265003040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.46	0.00	0.01
St. Louis City	2265003050	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.02	0.00	0.00
St. Louis City	2265003060	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.01	0.00	0.00
St. Louis City	2265003070	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.01	0.00	0.00
St. Louis City	2265004010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Residential)	Lawn and Garden	1.74	0.02	0.15
St. Louis City	2265004011	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn Mowers (Commercial)	Lawn and Garden	0.78	0.01	0.05
St. Louis City	2265004015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Residential)	Lawn and Garden	0.15	0.00	0.01
St. Louis City	2265004016	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rotary Tillers < 6 HP (Commercial)	Lawn and Garden	0.44	0.00	0.03
St. Louis City	2265004025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Residential)	Lawn and Garden	0.01	0.00	0.00
St. Louis City	2265004026	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Trimmers/Edgers/Brush Cutters (Commercial)	Lawn and Garden	0.02	0.00	0.00
St. Louis City	2265004030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Residential)	Lawn and Garden	0.02	0.00	0.00

St. Louis City	2265004031	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.97	0.01	0.03
St. Louis City	2265004035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Residential)	Lawn and Garden	0.00	0.00	0.01
St. Louis City	2265004036	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2265004040	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Residential)	Lawn and Garden	0.54	0.00	0.02
St. Louis City	2265004041	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Rear Engine Riding Mowers (Commercial)	Lawn and Garden	0.15	0.00	0.00
St. Louis City	2265004046	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.18	0.00	0.00
St. Louis City	2265004051	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Shredders < 6 HP (Commercial)	Lawn and Garden	0.05	0.00	0.00
St. Louis City	2265004055	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Residential)	Lawn and Garden	7.23	0.05	0.21
St. Louis City	2265004056	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	2.01	0.01	0.04
St. Louis City	2265004066	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.21	0.00	0.00
St. Louis City	2265004071	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	5.58	0.04	0.12
St. Louis City	2265004075	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Residential)	Lawn and Garden	0.22	0.00	0.01
St. Louis City	2265004076	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.17	0.00	0.01
St. Louis City	2265006005	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Generator Sets	Commercial Equipment	5.19	0.04	0.14

St. Louis City	2265006010	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pumps	Commercial Equipment	1.02	0.01	0.03
St. Louis City	2265006015	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Air Compressors	Commercial Equipment	0.49	0.01	0.01
St. Louis City	2265006025	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Welders	Commercial Equipment	1.34	0.01	0.03
St. Louis City	2265006030	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Pressure Washers	Commercial Equipment	2.05	0.02	0.06
St. Louis City	2265006035	Mobile Sources	Off-highway Vehicle Gasoline, 4-Stroke	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.10	0.00	0.00
St. Louis City	2267003010	Mobile Sources	LPG	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.03	0.01	0.00
St. Louis City	2267003020	Mobile Sources	LPG	Industrial Equipment	Forklifts	Industrial Equipment	0.98	0.16	0.02
St. Louis City	2267003030	Mobile Sources	LPG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.00	0.00
St. Louis City	2267003040	Mobile Sources	LPG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2267003050	Mobile Sources	LPG	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2267003070	Mobile Sources	LPG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2267004066	Mobile Sources	LPG	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.01	0.00	0.00
St. Louis City	2267006005	Mobile Sources	LPG	Commercial Equipment	Generator Sets	Commercial Equipment	0.07	0.02	0.00
St. Louis City	2267006010	Mobile Sources	LPG	Commercial Equipment	Pumps	Commercial Equipment	0.01	0.00	0.00
St. Louis City	2267006015	Mobile Sources	LPG	Commercial Equipment	Air Compressors	Commercial Equipment	0.01	0.00	0.00
St. Louis City	2267006025	Mobile Sources	LPG	Commercial Equipment	Welders	Commercial Equipment	0.01	0.00	0.00
St. Louis City	2267006030	Mobile Sources	LPG	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2267006035	Mobile Sources	LPG	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00

St. Louis City	2268003020	Mobile Sources	CNG	Industrial Equipment	Forklifts	Industrial Equipment	0.08	0.01	0.01
St. Louis City	2268003030	Mobile Sources	CNG	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2268003040	Mobile Sources	CNG	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2268003060	Mobile Sources	CNG	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2268003070	Mobile Sources	CNG	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2268006005	Mobile Sources	CNG	Commercial Equipment	Generator Sets	Commercial Equipment	0.03	0.01	0.00
St. Louis City	2268006010	Mobile Sources	CNG	Commercial Equipment	Pumps	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2268006015	Mobile Sources	CNG	Commercial Equipment	Air Compressors	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2268006020	Mobile Sources	CNG	Commercial Equipment	Gas Compressors	Commercial Equipment	0.02	0.00	0.00
St. Louis City	2270003010	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Aerial Lifts	Industrial Equipment	0.01	0.01	0.00
St. Louis City	2270003020	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Forklifts	Industrial Equipment	0.03	0.07	0.00
St. Louis City	2270003030	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Sweepers/Scrubbers	Industrial Equipment	0.01	0.04	0.00
St. Louis City	2270003040	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other General Industrial Equipment	Industrial Equipment	0.01	0.04	0.00
St. Louis City	2270003050	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Other Material Handling Equipment	Industrial Equipment	0.00	0.00	0.00
St. Louis City	2270003060	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	AC\Refrigeration	Industrial Equipment	0.03	0.09	0.01
St. Louis City	2270003070	Mobile Sources	Off-highway Vehicle Diesel	Industrial Equipment	Terminal Tractors	Industrial Equipment	0.01	0.03	0.00
St. Louis City	2270004031	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Leafblowers/Vacuums (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2270004036	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Snowblowers (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2270004046	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Front Mowers (Commercial)	Lawn and Garden	0.01	0.02	0.00
St. Louis City	2270004056	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Lawn and Garden Tractors (Commercial)	Lawn and Garden	0.00	0.00	0.00

St. Louis City	2270004066	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Chippers/Stump Grinders (Commercial)	Lawn and Garden	0.01	0.04	0.00
St. Louis City	2270004071	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Turf Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2270004076	Mobile Sources	Off-highway Vehicle Diesel	Lawn and Garden Equipment	Other Lawn and Garden Equipment (Commercial)	Lawn and Garden	0.00	0.00	0.00
St. Louis City	2270006005	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Generator Sets	Commercial Equipment	0.05	0.12	0.01
St. Louis City	2270006010	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pumps	Commercial Equipment	0.01	0.03	0.00
St. Louis City	2270006015	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Air Compressors	Commercial Equipment	0.02	0.06	0.00
St. Louis City	2270006025	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Welders	Commercial Equipment	0.04	0.04	0.01
St. Louis City	2270006030	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Pressure Washers	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2270006035	Mobile Sources	Off-highway Vehicle Diesel	Commercial Equipment	Hydro-power Units	Commercial Equipment	0.00	0.00	0.00
St. Louis City	2282005010	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Outboard	Pleasure Marine	0.25	0.01	0.10
St. Louis City	2282005015	Mobile Sources	Pleasure Craft	Gasoline 2-Stroke	Personal Water Craft	Pleasure Marine	0.12	0.01	0.02
St. Louis City	2282010005	Mobile Sources	Pleasure Craft	Gasoline 4-Stroke	Inboard/Sterndrive	Pleasure Marine	0.16	0.01	0.02
St. Louis City	2282020005	Mobile Sources	Pleasure Craft	Diesel	Inboard/Sterndrive	Pleasure Marine	0.00	0.01	0.00
St. Louis City	2282020010	Mobile Sources	Pleasure Craft	Diesel	Outboard	Pleasure Marine	0.00	0.00	0.00
St. Louis City	2285002015	Mobile Sources	Railroad Equipment	Diesel	Railway Maintenance	Railway Maintenance	0.00	0.01	0.00
St. Louis City	2285004015	Mobile Sources	Railroad Equipment	Gasoline, 4-Stroke	Railway Maintenance	Railway Maintenance	0.01	0.00	0.00
St. Louis City	2285006015	Mobile Sources	Railroad Equipment	LPG	Railway Maintenance	Railway Maintenance	0.00	0.00	0.00
<b>St. Louis City Total</b>							<b>35.76</b>	<b>1.15</b>	<b>1.73</b>
<b>Nonattainment Area Total</b>							<b>409.05</b>	<b>16.24</b>	<b>22.40</b>

Nonroad – Commercial Marine Vessels

County Name	SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	CO	NO <sub>x</sub>	VOC
Franklin	2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine	0.000	0.000	0.000
Franklin	2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine	0.000	0.000	0.000
<b>Franklin Total (Boles Township Only)</b>						<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
St. Charles	2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine	0.045	0.398	0.026
St. Charles	2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine	0.057	0.367	0.011
<b>St. Charles Total</b>						<b>0.102</b>	<b>0.765</b>	<b>0.037</b>
Jefferson	2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine	0.03	0.30	0.02
Jefferson	2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine	0.03	0.20	0.01
<b>Jefferson Total</b>						<b>0.06</b>	<b>0.49</b>	<b>0.03</b>
St. Louis	2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine	0.029	0.275	0.019
St. Louis	2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine	0.085	0.545	0.016
<b>St. Louis County Total</b>						<b>0.115</b>	<b>0.820</b>	<b>0.035</b>
St. Louis city	2280002101	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Port emissions: Main Engine	0.028	0.254	0.017
St. Louis city	2280002102	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Port emissions: Auxiliary Engine	0.117	0.749	0.022
St. Louis city	2280002201	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Main Engine	0.015	0.141	0.010
St. Louis city	2280002202	Mobile Sources	Marine Vessels, Commercial	Diesel	C1C2 Underway emissions: Auxiliary Engine	0.034	0.216	0.006
<b>St. Louis City Total</b>						<b>0.195</b>	<b>1.360</b>	<b>0.055</b>
<b>Area Total</b>						<b>0.47</b>	<b>3.44</b>	<b>0.15</b>

Nonroad - Locomotive

County Name	SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	CO	NO <sub>x</sub>	VOC
Franklin	2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations	0.046	0.232	0.011
Franklin	2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II / III Operations	0.001	0.009	0.000
Franklin	2285002008	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Passenger Trains (Amtrak)	0.002	0.014	0.001
<b>Franklin Total (Boles Township Only)</b>						<b>0.049</b>	<b>0.254</b>	<b>0.012</b>
Jefferson	2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations	0.09	0.45	0.02
Jefferson	2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II / III Operations	0.00	0.00	0.00
Jefferson	2285002008	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Passenger Trains (Amtrak)	0.01	0.05	0.00
<b>Jefferson Total</b>						<b>0.76</b>	<b>4.12</b>	<b>0.02</b>
St. Charles	28500201	Internal Combustion Engines	Railroad Equipment	Diesel	Yard Locomotives	0.017	0.107	0.007
St. Charles	2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations	0.137	0.695	0.032
<b>St. Charles Total</b>						<b>0.154</b>	<b>0.802</b>	<b>0.039</b>
St. Louis	28500201	Internal Combustion Engines	Railroad Equipment	Diesel	Yard Locomotives	0.006	0.036	0.002
St. Louis	2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations	0.218	1.104	0.051
St. Louis	2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II / III Operations	0.010	0.081	0.004
St. Louis	2285002008	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Passenger Trains (Amtrak)	0.010	0.067	0.004
<b>St. Louis County Total</b>						<b>0.243</b>	<b>1.287</b>	<b>0.061</b>
St. Louis city	28500201	Internal Combustion Engines	Railroad Equipment	Diesel	Yard Locomotives	0.128	0.822	0.054
St. Louis city	2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations	0.067	0.340	0.016
St. Louis city	2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II / III Operations	0.009	0.072	0.003
St. Louis city	2285002008	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Passenger Trains (Amtrak)	0.005	0.036	0.002
<b>St. Louis City Total</b>						<b>0.210</b>	<b>1.270</b>	<b>0.075</b>
<b>Area Total</b>						<b>0.76</b>	<b>4.12</b>	<b>0.21</b>



Nonroad - Aircraft

County Name	SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	CO	NO <sub>x</sub>	VOC
Franklin	2275001000	Mobile Sources	Aircraft	Military Aircraft	Total	0.0003	0.0003	0.0001
Franklin	2275050011	Mobile Sources	Aircraft	General Aviation	Piston	0.0260	0.0001	0.0003
Franklin	2275050012	Mobile Sources	Aircraft	General Aviation	Turbine	0.0079	0.0003	0.0006
Franklin	2275060011	Mobile Sources	Aircraft	Air Taxi	Piston	0.0015	0.0000	0.0000
Franklin	2275060012	Mobile Sources	Aircraft	Air Taxi	Turbine	0.0007	0.0001	0.0002
<b>Franklin Total (Boles Township Only)</b>						<b>0.0364</b>	<b>0.0008</b>	<b>0.0012</b>
Jefferson	2275001000	Mobile Sources	Aircraft	Military Aircraft	Total	0.00	0.00	0.00
Jefferson	2275050011	Mobile Sources	Aircraft	General Aviation	Piston	0.08	0.00	0.00
Jefferson	2275050012	Mobile Sources	Aircraft	General Aviation	Turbine	0.03	0.00	0.00
<b>Jefferson Total</b>						<b>0.11</b>	<b>0.00</b>	<b>0.00</b>
St. Charles	2275050011	Mobile Sources	Aircraft	General Aviation	Piston	0.4088	0.0022	0.0051
St. Charles	2275050012	Mobile Sources	Aircraft	General Aviation	Turbine	0.1260	0.0043	0.0091
St. Charles	2275060011	Mobile Sources	Aircraft	Air Taxi	Piston	0.0005	0.0000	0.0000
St. Charles	2275060012	Mobile Sources	Aircraft	Air Taxi	Turbine	0.0002	0.0001	0.0001
<b>St. Charles Total</b>						<b>0.5356</b>	<b>0.0065</b>	<b>0.0143</b>
St. Louis	2275001000	Mobile Sources	Aircraft	Military Aircraft	Total	0.0483	0.0416	0.0202
St. Louis	2275020000	Mobile Sources	Aircraft	Commercial Aircraft	Total: All Types	6.7317	2.5730	0.8537
St. Louis	2275050011	Mobile Sources	Aircraft	General Aviation	Piston	2.5680	0.0052	0.0760

County Name	SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	CO	NO <sub>x</sub>	VOC
St. Louis	2275050012	Mobile Sources	Aircraft	General Aviation	Turbine	0.3292	0.0127	0.0274
St. Louis	2275060011	Mobile Sources	Aircraft	Air Taxi	Piston	0.0550	0.0003	0.0005
St. Louis	2275060012	Mobile Sources	Aircraft	Air Taxi	Turbine	0.8123	0.1426	0.1234
St. Louis	2275070000	Mobile Sources	Aircraft	Aircraft Auxiliary Power Units	Total	0.1998	0.1541	0.0157
<b>St. Louis County Total</b>						<b>10.7443</b>	<b>2.9295</b>	<b>1.1169</b>
St. Louis city	2275050011	Mobile Sources	Aircraft	General Aviation	Piston	0.1249	0.0007	0.0016
St. Louis city	2275050012	Mobile Sources	Aircraft	General Aviation	Turbine	0.0412	0.0014	0.0030
<b>St. Louis City Total</b>						<b>0.1661</b>	<b>0.0021</b>	<b>0.0045</b>
<b>Area Total</b>						<b>11.59</b>	<b>2.94</b>	<b>1.14</b>

## Onroad

Appendix A provides a description of the development of the onroad emissions source categories. The summary table below provides these emissions in tons/ozone season day for the St. Louis ozone nonattainment area counties. All MOVES input databases used to develop these emission estimates are available, in electronic format, for inspection and review upon request to the air program.

### Onroad Emissions

County Name	CO	NO <sub>x</sub>	VOC
Franklin- Boles only	6.612	1.511	0.603
Jefferson	45.89	8.82	4.27
St. Charles	57.811	10.695	5.017
St. Louis	161.019	33.811	14.156
St. Louis City	40.418	9.825	4.519
<b>Total</b>	<b>311.75</b>	<b>66.66</b>	<b>28.57</b>

Event

Fires

County	Type	SCC	CO	NOx	VOC
Franklin	RX	2811015001	1.17	0.01	0.27
		2811015002	5.05	0.10	1.20
	WF	2810001001	0.03	0.00	0.01
		2810001002	0.13	0.00	0.03
	Total		6.37	0.10	1.51
Jefferson	RX	2811015001	3.57	0.02	0.83
		2811015002	15.16	0.28	3.60
	WF	2810001001	0.06	0.00	0.01
		2810001002	0.32	0.01	0.08
	Total		19.11	0.31	4.52
St Charles	RX	2811015001	0.98	0.00	0.23
		2811015002	3.14	0.06	0.75
	WF	2810001001	0.01	0.00	0.00
		2810001002	0.01	0.00	0.00
	Total		4.14	0.07	0.98
St Louis Co	RX	2811015001	0.09	0.00	0.02
		2811015002	0.39	0.01	0.09
	Total		0.48	0.01	0.11
Grand Total			30.11	0.48	7.12

Biogenic

County	CO	NOx	VOC
Franklin Co	0.62	0.23	5.85
Jefferson	2.77	0.60	31.66
St Charles Co	1.96	0.86	12.58

St Louis	0.51	0.10	1.80
St Louis Co	2.06	0.49	12.71
<b>Total</b>	<b>7.92</b>	<b>2.29</b>	<b>64.62</b>

## **Appendix C**

### **2017 Nonpoint Inventory Documentation**

Nonpoint categories include those too numerous or dispersed to inventory on an individual basis. These include residential pollution sources like home heating, painting, outdoor burning, small businesses like autobody repair shops, dry cleaners, and gas stations, and agricultural sources like livestock production and fertilizer application. Emissions from these categories are estimated using data for various industries and applying emission rates to them, then allocating those emissions to geographic areas based on population, employment, or other activity data. Many of the varied sources in the nonpoint category are estimated using tools provided by EPA using the latest methods and data available.

#### **Wagon Wheel Categories**

The Wagon Wheel Tool is a Microsoft Office Access-based tool that was developed to simplify the nonpoint National Emissions Inventory (NEI) process. It is made up of a series of linked Access databases that contain the data and queries used to calculate emissions for various NEI SCCs. The majority of nonpoint categories are included in the Wagon Wheel tool. Documentation for the categories listed in the table below begin on page 186.

<b>Nonpoint Category</b>	<b>SCC Descriptive Category</b>
Agricultural Pesticides	Solvent – Consumer and Commercial Use
Agricultural Tilling	Agriculture – Crops and Livestock Dust
Asphalt Paving	Solvent – Consumer and Commercial Solvent Use
Aviation Gasoline	Gas Stations
Commercial Cooking	Commercial Cooking
Compost	Waste Disposal
Construction Dust	Dust- Construction Dust
Open Burning	Waste Disposal

<b>Nonpoint Category</b>	<b>SCC Descriptive Category</b>
Cremation	Miscellaneous Non-industrial Not Elsewhere Classified
Dust from Hooves	Agriculture – Crops and Livestock Dust
Industrial and Commercial/institutional Fuel Combustion	Fuel Combustion – Commercial/Institutional and Industrial: Biomass, Coal, Natural Gas, Oil, Other
Landfills	Waste Disposal
Mining and Quarrying	Industrial Processes - Mining
Other Mercury	Miscellaneous Non-industrial Not Elsewhere Classified
Publicly Owned Treatment Works	Waste Disposal
Residential Grilling	Miscellaneous Non-industrial Not Elsewhere Classified
Residential Heating	Fuel Combustion – Residential Natural Gas, Oil, Other
Road Dust	Dust- Paved Road Dust, Dust – Unpaved Road Dust
Residential Wood Combustion	Fuel Combustion – Residential- Wood
Solvents	Solvent – Consumer and Commercial Solvent Use, Degreasing, Graphic Arts, Industrial Surface Coating and Solvent Use, Nonindustrial Surface Coating
Stage 1 Gasoline Distribution	Bulk Gasoline Terminals, Gas Stations, Industrial Processes – Storage and Transfer

### Non-Wagon Wheel categories

These categories are estimated outside of the Wagon Wheel tool. The air program accepted the EPA estimates for these categories after reviewing the activity and emission data.

Documentation for agricultural burning is below, followed by agricultural fertilizer on page 4, and oil and gas on page 37.

### Agricultural Burning

EPA estimates this emission source using remote sensing data. These estimates are then reviewed by the states and are revised if resources allow. Remote sensing is necessary to fill in the gaps for regions where there is no other source of data. Crop residue emissions result from either pre-harvest or post-harvest burning of agricultural fields. The crop residue emission inventory for 2017 is a day-specific, with geolocation information by crop type.

For the 2017 NEI, updated VOC and HAP emission factors were derived by EPA from the original measurement found in the SPECIATE database. The measurement study was focused on wheat straw and rice straw burning. Except for sugarcane and grasslands, emission factors for the remaining crop types are the average of these two crops. For sugarcane emissions, a new HAP emission factor source was incorporated to the dataset, with a separate reference providing VOC for sugarcane. Sugarcane is unique because it is the only crop type that is burned pre-harvest and has different VOC emission factors compared to other crop types. In this dataset, all HAP emission factors are made consistent with the VOC speciation derived from the SPECIATE profiles.

The dataset also calculated the heat release of each fire. This information is needed for a plume rise calculation within a chemical transport modeling system.

The satellite detection method in previous NEI cycles often turned up false-positive agricultural burning areas, particularly in areas with dark soil that cannot be differentiated from burn scars. Satellite detections exclude areas covered by snow during the winter months, and certain crop types (corn and soybeans) are excluded from these Midwestern states: Iowa, Kansas, Indiana, Illinois, Michigan, Missouri, Minnesota, Wisconsin, Ohio.

Additionally, to avoid double counting with the wildfire inventory, all grassland detections of fires outside of the Flint Hills in Kansas and Oklahoma have been incorporated into the wildfire and prescribed fire inventory process and are not part of the agricultural fire dataset (they will be included as appropriate in our wildland fire inventory, which is part of the “EVENTS” data category).

## Agricultural Fertilizer

### 1.1.1 EPA-developed emissions for fertilizer application

Direct flux measurements of ammonia ( $\text{NH}_3$ ) over agricultural fields and natural vegetation over the past few decades have demonstrated that vegetation and soil can either be a source or a sink of atmospheric  $\text{NH}_3$ . The direction and magnitude of the exchange depends on the concentration gradient between the canopy and the atmosphere. The bidirectional approach taken here accounts, in the most comprehensive way possible, for estimated  $\text{NH}_3$  emissions from this complex process. The  $\text{NH}_3$  emissions estimated here are for fertilizer that has been applied to the soil. Emissions from the application processes are estimated in the manure management portion of livestock emissions. The approach to calculating emissions from this sector in 2017 is consistent with the methodology used for the 2014 NEI. The bidirectional version of CMAQ (v5.3) [ref 1] and the Fertilizer Emissions Scenario Tool for CMAQ FEST-C (v1.3) [ref 2] were used to estimate ammonia ( $\text{NH}_3$ ) emissions from agricultural soils. These estimates were then loaded into EIS for use in the 2017 NEI. The approach to estimate 2017 fertilizer emissions consists of these steps:

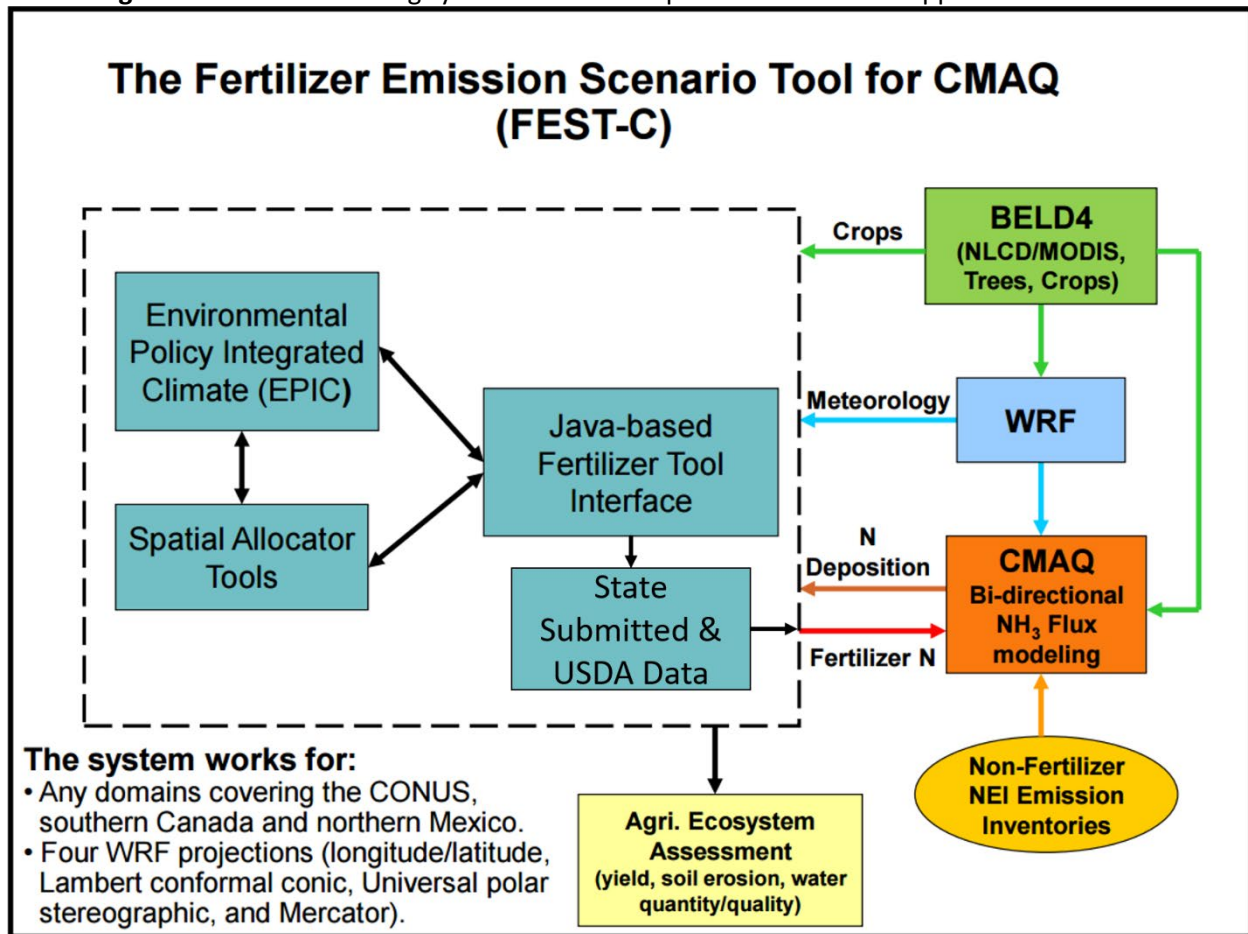
- Run FEST-C to produce nitrate ( $\text{NO}_3$ ), Ammonium ( $\text{NH}_4^+$ , including Urea), and organic (manure) nitrogen (N) fertilizer usage estimates
- Use USDA Economic Research Services crop specific fertilizer use data and state submitted data to adjust the FEST-C fertilizer totals to match the USDA and State submitted.
- CMAQ model with bidirectional (“bidi”)  $\text{NH}_3$  exchange to generate gaseous ammonia  $\text{NH}_3$  emission estimates.
- Calculate county-level emission factors as the ratio of bidirectional CMAQ  $\text{NH}_3$  fertilizer emissions to FEST-C total N fertilizer application.
- Assign the  $\text{NH}_3$  emissions to one SCC: “...Miscellaneous Fertilizers” (2801700099).

An iterative calculation will be applied to estimate fertilizer emissions for the 2017 NEI. We first estimate fertilizer application by crop type for 2017 using FEST-C modeled data. After receipt and addressing of comments to the extent possible, we then adjusted the 2017 fertilizer application estimates using state submitted data, currently only Iowa, and USDA Economic Research Service state and crop specific survey data. The USDA and state submitted annual fertilizer data was used to estimate the ratio of USDA/state fertilizer use to FEST-C annual total fertilizer estimates for each state and crop with USDA or state data. This ratio is then applied to the FEST-C fertilizer application rates for each state and crop with data. A maximum annual fertilization rate was estimated from the FEST-C simulation and annual adjusted totals were limited to this rate to prevent unrealistically higher fertilization rates. Then we ran the CMAQ v5.3 model with the Surface Tiled Aerosol and Gaseous Exchange (STAGE) deposition option with bidirectional exchange to estimate fertilizer and biogenic  $\text{NH}_3$  emissions for 2017. We use this approach for three reasons: (1) FEST-C estimates fertilizer applications based on crop nutrient needs which is typically lower than real world fertilization rates; (2) FEST-C fertilizer timing and application methods are assumed to be correct; and (3) We desired a method to incorporate state submitted and USDA reported data into the final fertilization emission estimates.

FEST-C is the software program that processes land use and agricultural activity data to develop inputs for the CMAQ model when run with bidirectional exchange. FEST-C reads land use data from the Biogenic Emissions Landuse Dataset (BELD), meteorological variables from the Weather Research and Forecasting model [ref 3], and nitrogen deposition data from a previous or historical average CMAQ simulation. FEST-C, then uses the USDA’s Environmental Policy Integrated Climate (EPIC) modeling system [ref 4] to simulate the agricultural practices and soil biogeochemistry and provides information regarding fertilizer timing, composition, application method and amount.

Figure 4-1 provides a comprehensive flowchart of the complete EPIC/FEST-C/WRF “bidi” modeling system.

**Figure 4-1:** “Bidi” modeling system used to compute 2014 Fertilizer Application emissions



#### 1.1.1.1 Activity Data

The following activity parameters were input into the EPIC model:

- Grid cell meteorological variables from WRF (see Table 4-16)
- Initial soil profiles/soil selection
- Presence of 21 major crops: irrigated and rain fed hay, alfalfa, grass, barley, beans, grain corn, silage corn, cotton, oats, peanuts, potatoes, rice, rye, grain sorghum, silage sorghum, soybeans, spring wheat, winter wheat, canola, and other crops (e.g. lettuce, tomatoes, etc.)
- Fertilizer sales to establish the type/composition of nutrients applied
- Management scenarios for the 10 USDA production regions (Figure 4-2) [ref 5]. These include irrigation, tile drainage, intervals between forage harvest, fertilizer application method (injected versus surface applied), and equipment commonly used in these production regions.

**Figure 4-2:** USDA farm production regions used in FT-C simulations



We used the WRF meteorological model to provide grid cell meteorological parameters for 2016 using a national 12-km rectangular grid covering the continental U.S. The meteorological parameters in Table 4-16 were used as EPIC model inputs.

**Table 4-1.** Environmental variables needed for an EPIC simulation

EPIC input variable	Variable Source
Daily Total Radiation ( $\text{MJ m}^{-2}$ )	WRF
Daily Maximum 2-m Temperature (C)	WRF
Daily minimum 2-m temperature (C)	WRF
Daily Total Precipitation (mm)	WRF
Daily Average Relative Humidity (unitless)	WRF
Daily Average 10-m Wind Speed ( $\text{m s}^{-1}$ )	WRF
Daily Total Wet Deposition Oxidized N (g/ha)	CMAQ
Daily Total Wet Deposition Reduced N (g/ha)	CMAQ
Daily Total Dry Deposition Oxidized N (g/ha)	CMAQ
Daily Total Dry Deposition Reduced N (g/ha)	CMAQ
Daily Total Wet Deposition Organic N (g/ha)	CMAQ

Initial soil nutrient and pH conditions in EPIC are based on the 1992 USDA Soil Conservation Service (CSC) Soils-5 survey. The EPIC model then is run for 25 years using current fertilization and agricultural cropping techniques to estimate soil nutrient content and pH for the 2017 EPIC/WRF/CMAQ simulation.

The presence of crops in each model grid cell was determined through the use of USDA Census of Agriculture data (2012) and USGS National Land Cover data (2011). These two data sources were used to compute the fraction of agricultural land in a model grid cell and the mix of crops grown on that land.

Fertilizer sales data and the 6-month period in which they were sold were extracted from the 2014 Association of American Plant Food Control Officials (AAPFCO). AAPFCO data are used to identify the composition (e.g. urea, nitrate, organic) of the fertilizer used, and the amount applied is estimated using the modeled crop demand. These data are useful in making a reasonable assignment of what kind of fertilizer is being applied to which crops.

Management activity data refers to data used to estimate representative crop management schemes. We used the USDA Agricultural Resource Management Survey (ARMS) to provide management activity data. These data cover 10 USDA production regions and provide management schemes for irrigated and rain fed hay, alfalfa, grass, barley, beans, grain corn, silage corn, cotton, oats, peanuts, potatoes, rice, rye, grain sorghum, silage sorghum, soybeans, spring wheat, winter wheat, canola, and other crops (e.g. lettuce, tomatoes, etc.).

The variables shown below are provided in the “2017\_Fertilizer\_Application\_vx.x\_xnov2017.zip” file for purposes of assessing crop data:

- Fertilizer application timing
- Plant/harvest dates
- Fertilizer application rates by crop and county
- Area planted
- Crop yields

#### 1.1.1.2 Emission Factors

The emission factors were derived from the 2017 CMAQ FEST-C outputs. Total fertilizer emission factors for each month and county were computed by taking the ratio of total fertilizer NH<sub>3</sub> emissions (short tons) to total nitrogen fertilizer application (short tons).

12 km by 12 km gridded NH<sub>3</sub> emissions were mapped to a county shape file polygon. The cell was assigned to a county if the grid centroid fell within the county boundary. Example Calculation

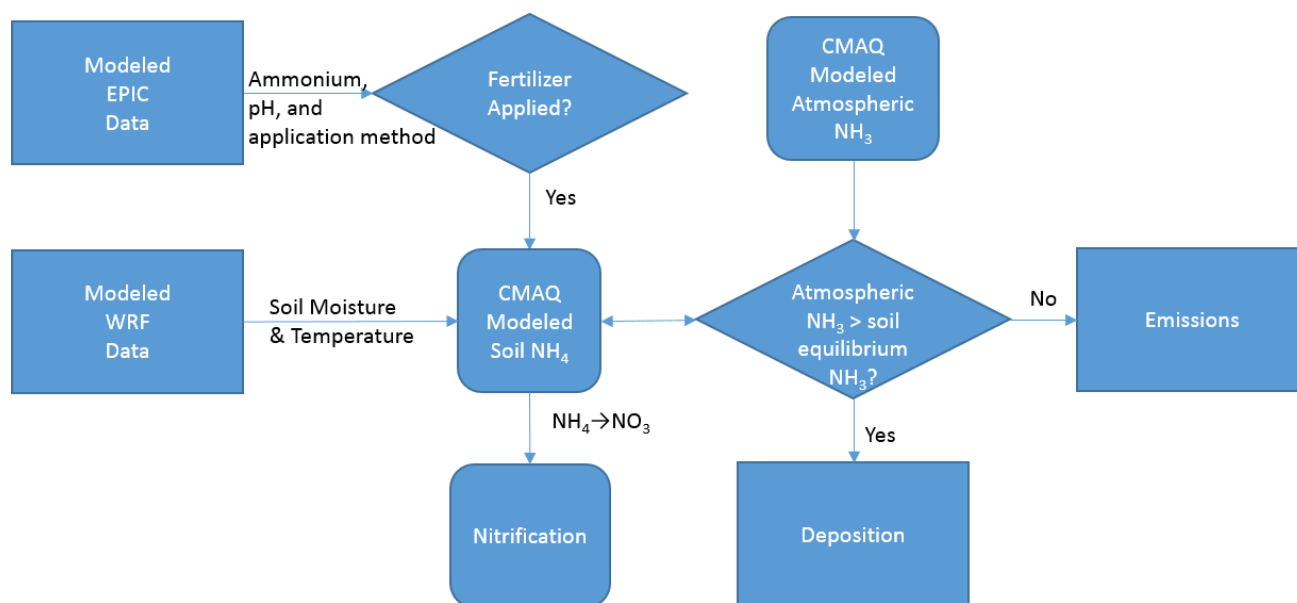
Adjustment of FEST-C fertilizer rates using state or USDA data:

$$Fert_{adjusted,crop} = \max \left( \frac{Fert_{submitted,crop}}{\frac{1}{n_{crop}} \sum Fert_{FEST-C,crop}}, Fert_{FEST-C,crop}, Fert_{max,crop} \right)$$

Where  $Fert_{adjusted,crop}$  is the FEST-C 12km grid cell adjusted fertilization rate,  $Fert_{submitted,i}$  is the USDA or State submitted state mean annual application data for the specified crop, in kg ha<sup>-1</sup>,  $FERT_{FEST-C,i}$  is the initial FEST-C 12km grid cell fertilization rate for the state being considered,  $n_{crop}$  is the number of grid cells with fertilization use for the specified crop in the state, and  $Fert_{max,crop}$  is the maximum fertilization rate estimated from EPIC for the crop.

County-level fertilizer emissions (NH<sub>3</sub>) for 2017 are derived from the diagnostic emission output from a 2017 CMAQ FEST-C model simulation (for details see Bash et al. 2013). With this modeling system, it would be difficult to perform a sample calculation; this is not something that could be demonstrated in a spreadsheet. These emissions are computed via the full chemical transport model, as illustrated in Figure 4-3.

**Figure 4-3:** Simplified FEST-C system flow of operations in estimating NH<sub>3</sub> emissions



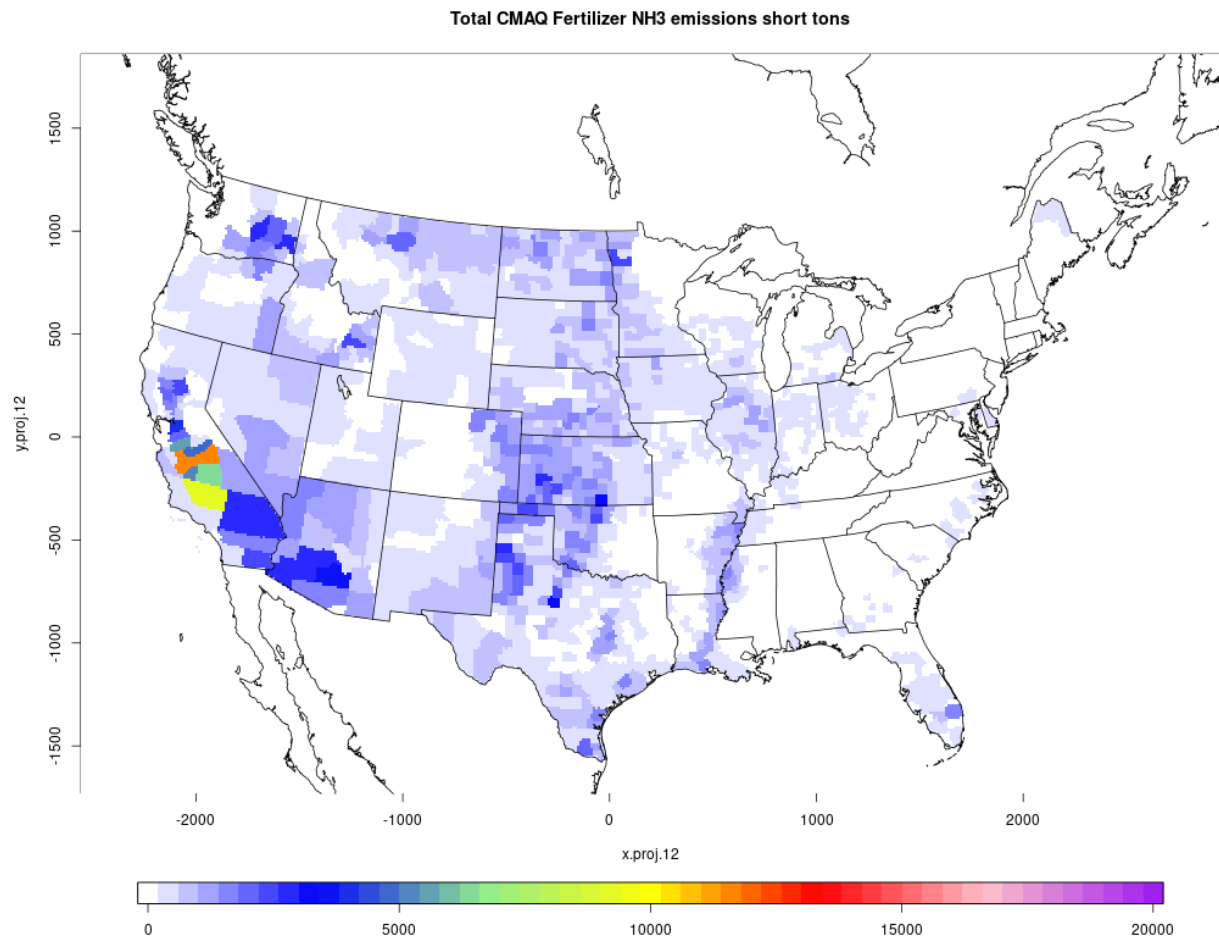
#### 1.1.1.3 Comparison to 2014 Methodology

The 2017 fertilizer estimates are based on the CMAQ FEST-C “bidirectional” approach outlined in Figure 4-3 that couples meteorological inputs, CMAQ and the EPIC modeling system through the FEST-C interface. This approach used for deriving ammonia emissions for the 2017 NEI is substantially the same as the approach used for the 2014 NEI fertilizer estimates,

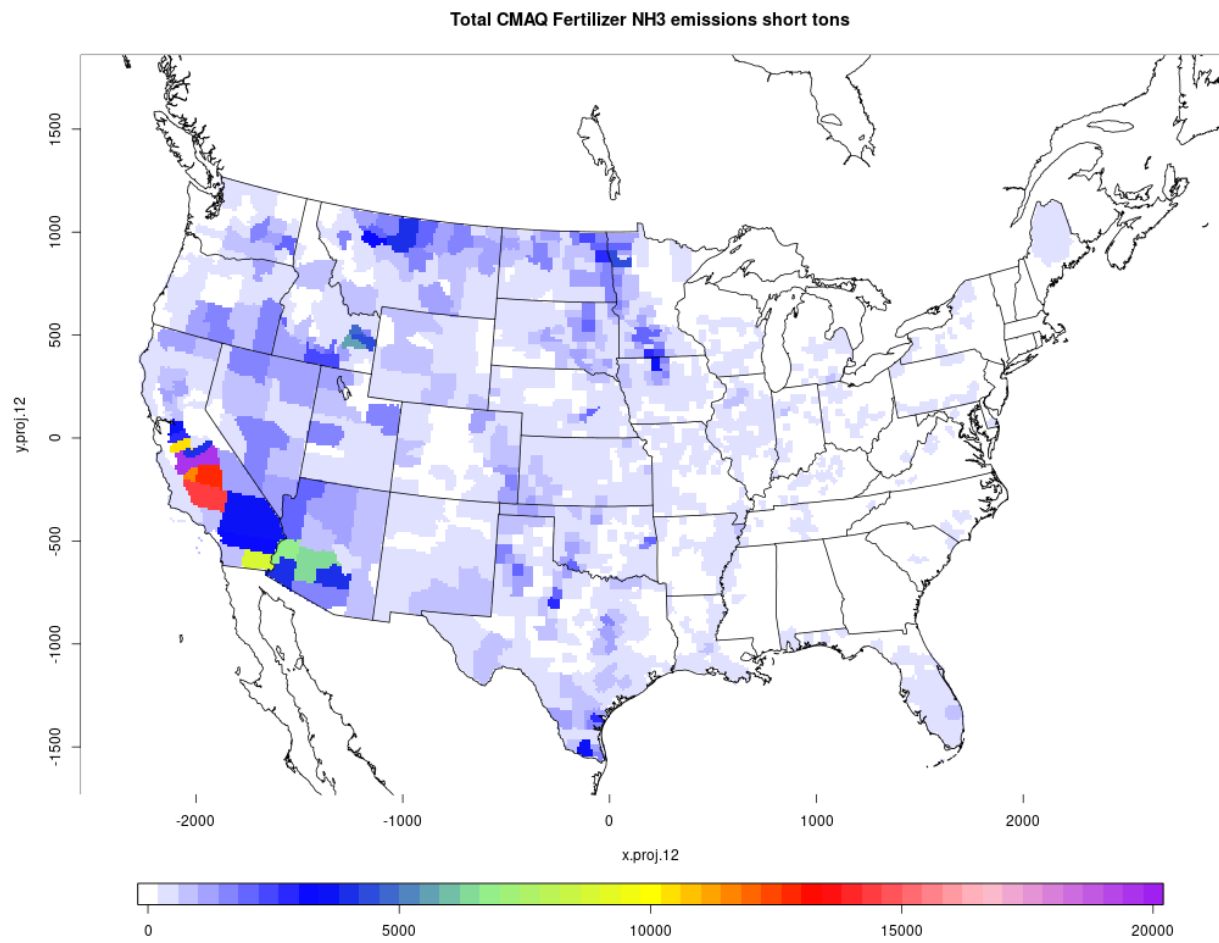
[https://www.epa.gov/sites/production/files/2018-07/documents/nei2014v2\\_tsd\\_05jul2018.pdf](https://www.epa.gov/sites/production/files/2018-07/documents/nei2014v2_tsd_05jul2018.pdf) section 4.4, however, newer model versions for CMAQ and FEST-C were used. These estimates used FEST-C v1.4 simulations with CMAQ 5.3 beta using the land use specific deposition option, Surface Tiled Aerosol and Gaseous Exchange (STAGE), and bidirectional NH<sub>3</sub> exchange. FEST-C v1.4 corrected an error in the nitrogen budget from an earlier version of the model used in the 2014 NEI. This results in approximately 38% lower fertilization estimates than used in the 2014 NEI, see Table 4-2, and thus lower emission estimates in much of the US, Figure 4-6. This emission reduction was largely offset when annual state and USDA fertilizer data was applied to the FEST-C rates. FEST-C fertilizer rates were approximately 20% lower than USDA and State data where available with the exceptions of wheat (50% under estimate) and cotton (60% under estimate). Crops without state or USDA fertilizer data were adjusted by the mean adjustment factor from all the crops with state or USDA submitted data, approximately 20%. Large

increase in fertilizer rates for cotton and wheat resulted in a large increase in NH<sub>3</sub> emissions from fertilizer due to the typically alkali soils and warm climate where these crops are grown. Emission maps for the 2014 NEI, these 2017 estimates , and difference maps are provided below in Figure 4-4, Figure 4-5 and Figure 4-6, respectively.

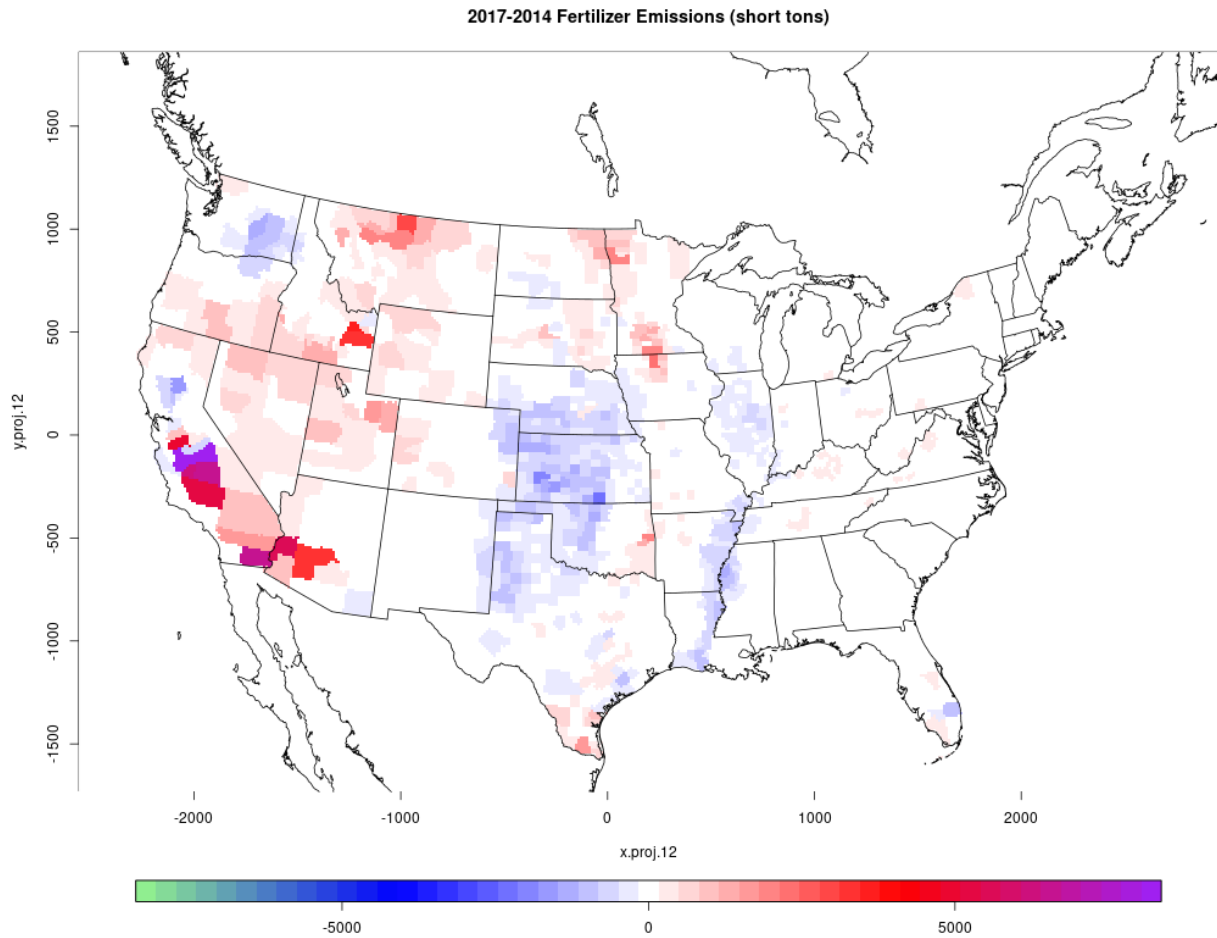
**Figure 4-4: NEI 2014 “bidi” Fertilizer Application Emissions**



**Figure 4-5: 2017 NEI “bidi” Fertilizer Application Emissions**



**Figure 4-6: 2017 -2014 NEI “bidi” Fertilizer Application Emissions in tons N**



**Table 4-1, Contiguous US fertilizer totals and emissions for the 2017 NEI and 2014 NEI**

	<b>2017 FINAL</b>	<b>2017 DRAFT</b>	<b>2014 V2</b>	<b>2014 V1</b>
<b>EPIC FERTILIZER APPLICATION</b>	13,604,640 tons N	11,451,713 tons N	18,851,866 tons N	20,314,303 tons N
<b>CMAQ EMISSIONS</b>	986,509 tons N	592,218 tons N	883,526 tons N	948,616 tons N

<b>MEAN ANNUAL EMISSIONS FACTOR*</b>	7.3% total, 12.5% of urea/NH <sub>4</sub>	4.8% total, 8.9% of urea/NH <sub>4</sub>	4.7% total, 9.8% of urea/NH <sub>4</sub>	4.7% total, 9.1% of urea/NH <sub>4</sub>
<b>FERTILIZER USE**</b>	Not Available	Not Available	13,295,000 tons N	12,814,000 tons N

\* Defined as the annual emissions divided by the annual fertilizer application

\*\* USDA Economic Research Service (<https://www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx>)

### 1.1.2 References for agriculture fertilizer application

1. Community Multiscale Air Quality (CMAQ v5.3) model, available at: <https://www.cmascenter.org/>
2. Fertilizer Emission Scenario Tool for CMAQ (FEST-C) system, available at: <https://www.cmascenter.org/fest-c/>
3. Weather Research Forecast (WRF) model, available at: <http://www.wrf-model.org/index.php>
4. Environmental Policy Integrated Climate (EPIC) model, available for download at: <http://epicapex.tamu.edu/>
5. Cooter, E.J., Bash, J.O., Benson V., Ran, L.-M.; Linking agricultural management and air-quality models for regional to national-scale nitrogen deposition assessments, Biogeosciences, 9, 4023-4035, 2012. Also available at: <http://www.biogeosciences.net/9/4023/2012/>

### 1.1.3 Additional technical information

FEST-C model outputs are discussed in detail in the “NH<sub>3</sub>\_Fert\_Fact\_Sheet\_v2.docx” included in the zip file “2017\_Fertilizer\_Application\_v1.0\_Nov2018.zip” available at: <ftp://ftp.epa.gov/EmisInventory/2017/doc/nonpoint/>

Additional Information regarding the 2014 methodology and the development of the 2017 methodology can be found in the 2014 NEI training, search for “Key NH<sub>3</sub> sectors”:

<https://www.epa.gov/air-emissions-inventories/air-emissions-inventory-training>

## AGRICULTURAL LIVESTOCK

### A. Source Category Description

Animal waste from livestock results in emissions of both NH<sub>3</sub> (ammonia) and Volatile Organic Compounds (VOCs). VOCs emitted by livestock can be defined as any compound of carbon (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate) that may participate in atmospheric photochemical reactions and is emitted by livestock. Livestock are domesticated farm animals raised in an agricultural setting for home use or profit. The following livestock are included in the NEI: beef cattle, dairy cattle, swine, poultry (layers, broilers and turkeys), goats, horses, and sheep.

For this source category, the SCCs in Table 1 were assigned.

**Table 1: Livestock Source Classification Codes**

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2805002000	Miscellaneous Area Sources	Agriculture Production - Livestock	Beef cattle production composite	Not Elsewhere Classified
2805018000	Miscellaneous Area Sources	Agriculture Production - Livestock	Dairy cattle composite	Not Elsewhere Classified
2805025000	Miscellaneous Area Sources	Agriculture Production - Livestock	Swine production composite	Not Elsewhere Classified
2805007100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - layers with dry manure management systems	Confinement
2805030004	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry Waste Emissions	Broilers
2805010100	Miscellaneous Area Sources	Agriculture Production - Livestock	Poultry production - turkeys	Confinement
2805045000	Miscellaneous Area Sources	Agriculture Production - Livestock	Goats Waste Emissions	Not Elsewhere Classified
2805035000	Miscellaneous Area Sources	Agriculture Production - Livestock	Horses and Ponies Waste Emissions	Not Elsewhere Classified
2805040000	Miscellaneous Area Sources	Agriculture Production - Livestock	Sheep and Lambs Waste Emissions	Total

## B. Overview of Calculations

The general approach to calculating NH<sub>3</sub> emissions due to livestock is to multiply the emission factor (in kg per year per animal) by the number of animals in the county. The state-level NH<sub>3</sub> emissions factors are generated using the CMU Ammonia Model (McQuilling and Adams, 2015). VOC emissions were estimated by multiplying a national VOC/NH<sub>3</sub> emissions ratio by the county-level NH<sub>3</sub> emissions. HAP emissions were estimated by multiplying the county-level VOC emissions by HAP/VOC ratios.

## C. Activity Data

The activity data for this source category is based on livestock counts (average annual number of standing head) and population information by state and county used to develop U.S. EPA's Greenhouse Gas Inventory [99]. This data set is derived from multiple data sets from the United States Department of Agriculture (USDA), particularly the National Agricultural Statistics Service (NASS) survey and census [100]. The USDA NASS survey dataset, which represents latest available, 2017 national livestock data, is used to obtain the livestock counts for as many counties as possible across the United States. For a full description of the GHG livestock population estimation methodology, refer to the above referenced citation for the EPA's GHG inventory document.

Generally, counties not specifically included in the NASS survey data set (e.g., due to business confidentially reasons) were gap-filled based on the difference in the reported state total animal counts and the sum of all county-level reported animal counts. State-level data on animal counts from the GHG inventory were distributed to counties based on the proportion of animal counts in those counties from the 2012 NASS census.

$$P_{a,c,2017} = P_{a,s,2017} \times r_{a,c,2012} \quad (1)$$

Where:

$P_{a,c,2017}$  = Estimated population of animal type  $a$  in county  $c$

$P_{a,s,2017}$  = NASS survey reported state-level population of animal type  $a$  in state  $s$

$r_{a,c,2012}$  = Ratio of animal county- to state-level animal counts from the 2012 NASS census for animal type  $a$  in county  $c$

## D. Allocation Procedure

The USDA survey reports the livestock counts at the county level for many counties, so no allocation is necessary. The procedure for gap-filling missing county-level data using state-level data is described in section C.

## E. Emissions Factors

CMU developed a model to estimate NH<sub>3</sub> emissions from livestock [18]. This model produces daily-resolved, climate level emissions factors for a particular distribution of management practices for each county and animal type, as expressed as emissions/animal. These county level emissions factors are then combined together to create a state level emissions factor for each animal type. For the 2014 NEI v2, these state level emissions factors were back calculated from the CMU model using statewide emissions divided by statewide animal totals. Thus, the CMU model provides a state specific emission factor for each animal type (NH<sub>3</sub> emissions/head).

To develop emissions factors for the 2017 NEI, the CMU model was modified to use hourly meteorological data and two runs were performed using 2014 and 2017 meteorological data. The ratio of

the 2017 to 2014 CMU model values were then applied to the 2014 back calculated state-level emissions factors to develop emissions factors for the 2017 NEI. VOC emission factors come from the ratio of NH<sub>3</sub> to VOC emissions in counties which provided an estimate of both pollutants in NEI 2014 v1. There were 106 counties which provided emissions for both pollutants, and the average ratio was 0.08 tons of VOC for every ton of NH<sub>3</sub>. This ratio is multiplied by all county level NH<sub>3</sub> emissions in NEI 2017 to estimate VOC emissions for each county. This ratio does not vary by state or animal type.

HAP emissions were estimated by multiplying county-specific VOC emissions by speciation factors that are animal-specific as shown in Table 2 below. All of the HAP VOC fractions were obtained from EPA's SPECIATE database [101]. As per the availability in SPECIATE, there are total of 6 VOC HAPs estimated for beef cattle, 5 VOC HAPs for dairy cattle, 4 VOC HAPs for swine, and 14 (same) VOC HAPs for layers and broilers (poultry).

**Table 2: VOC speciation fractions used to estimate HAP Emissions for the Livestock Sector**

SCC	Animal Type	HAP	Fraction of VOC	SPECIATE Profile Number
2805002000	Beef Cattle	1,4-Dichlorobenzene	0.0013	95240
2805002000	Beef Cattle	Methyl isobutyl Ketone	0.0008	
2805002000	Beef Cattle	Toluene	0.0110	
2805002000	Beef Cattle	Chlorobenzene	0.0001	
2805002000	Beef Cattle	Phenol	0.0006	
2805002000	Beef Cattle	Benzene	0.0001	
2805007100	Poultry---Layers	Methyl isobutyl ketone	0.0169	95223
2805007100	Poultry---Layers	Toluene	0.0018	
2805007100	Poultry---Layers	Phenol	0.0024	
2805007100	Poultry---Layers	N-hexane	0.0111	
2805007100	Poultry---Layers	Chloroform	0.0025	
2805007100	Poultry---Layers	Cresol/Cresylic Acid (mixed isomers)	0.0048	
2805007100	Poultry---Layers	Acetamide	0.0075	
2805007100	Poultry---Layers	Methanol	0.0608	
2805007100	Poultry---Layers	Benzene	0.0052	
2805007100	Poultry---Layers	Ethyl Chloride	0.0031	
2805007100	Poultry---Layers	Acetonitrile	0.0088	
2805007100	Poultry---Layers	Dichloromethane	0.0002	
2805007100	Poultry---Layers	Carbon Disulfide	0.0034	

SCC	Animal Type	HAP	Fraction of VOC	SPECIATE Profile Number
2805007100	Poultry---Layers	2-Methyl Napthalene	0.0006	95223
2805009100	Poultry-Broilers	Methyl isobutyl ketone	0.0169	
2805009100	Poultry-Broilers	Toluene	0.0018	
2805009100	Poultry-Broilers	Phenol	0.0024	
2805009100	Poultry-Broilers	N-hexane	0.0111	
2805009100	Poultry-Broilers	Chloroform	0.0025	
2805009100	Poultry-Broilers	Cresol/Cresylic Acid (mixed isomers)	0.0048	
2805009100	Poultry-Broilers	Acetamide	0.0075	
2805009100	Poultry-Broilers	Methanol	0.0608	
2805009100	Poultry-Broilers	Benzene	0.0052	
2805009100	Poultry-Broilers	Ethyl Chloride	0.0031	
2805009100	Poultry-Broilers	Acetonitrile	0.0088	
2805009100	Poultry-Broilers	Dichloromethane	0.0002	
2805009100	Poultry-Broilers	Carbon Disulfide	0.0034	
2805009100	Poultry-Broilers	2-Methyl Napthalene	0.0006	
2805018000	Dairy Cattle	Toluene	0.0018	8897
2805018000	Dairy Cattle	Cresol/Cresylic Acid (mixed isomers)	0.0276	
2805018000	Dairy Cattle	Xylenes (mixed isomers)	0.0046	
2805018000	Dairy Cattle	Methanol	0.3542	
2805018000	Dairy Cattle	Acetaldehyde	0.0141	
2805025000	Swine	Toluene	0.0047	95241
2805025000	Swine	Phenol (Carbolic Acid)	0.0179	
2805025000	Swine	Benzene	0.0035	
2805025000	Swine	Acetaldehyde	0.0155	

For the non-CMU animals (goats, sheep, horses, and turkeys), animal-specific HAP speciation profiles were not available in the literature, so the following assignments were made:

Sheep and Goats	Same HAP fractions as Dairy Cattle
Turkeys	Same HAP fractions as Chicken-Broilers
Horses	Same HAP fractions as Beef Cattle

### ***Meteorological Data Used in Adjusting FEM Emission Factors***

The source code provided for FEM model contained weather data for 2014. It did not use standard identifiers (WBAN ID) and was limited to a small number of observations with an unknown source. The FEM weather data used a single monthly value for wind, temperature, and precipitation. FEM interpolated this data to hourly using different techniques. For temperature, a standard deviation was used to raise and lower the mean temperature in the month. For wind speed, the average monthly value was used for all hours. For precipitation, monthly amounts were divided into days (an hours) based upon a parameter defining the frequency of rain in a month.

The source code was modified to accommodate a true hourly processing of the met data. For the years 2014 and 2017, ISD (Integrated Surface Database) files from NOAA were processed into a yearly-hourly data file. Individual weather station files were retrieved from <ftp://ftp.ncdc.noaa.gov/pub/data/noaa> for all stations in the US.

This is an automated process whereby a year and certain inclusion criteria are set (country codes, missing value limits, etc.) and a direct indexed file is created of all passing stations. In the case of FEM, all stations in the US were included with a maximum of 4000 missing hours for temperature and wind speed and a maximum of 40 consecutive hours without temperature or wind speed. The system automatically fills in missing values using linear interpolation between missing hours.

To determine the weather characteristics for the year, the county centroid is matched to the nearest weather station in the yearly-hourly file. Emissions factors are calculated using every hour of the year for the county location and the model farm types located within the county.

### ***Animal Practice Documentation***

Ammonia emissions from livestock depend on two major factors—the management practices employed by the producers (i.e. what housing, storage and application methods are used) and the environmental conditions of location where the farm is situated (i.e. temperatures, wind speeds, precipitation). All of these factors have significant impacts on the conditions of the manure and waste (e.g. water content, total ammoniacal nitrogen concentration) and as a result can enhance or reduce the emissions of ammonia from these sources.

The CMU model requires farm-type inputs which describe the type of animal housing, manure storage and application methods used for a particular location. Each location is expected to have some combination of practices; for example, in a single county, some of the swine farms may use deep-pit housing, lagoon storage, and irrigation application while other farms use shallow-pit housing with lagoon storage and injection application. In order to understand the differences in regional preferences for particular manure management strategies, information was extracted from the most recent National Animal Health Monitoring Surveys done by the USDA. The beef cattle NAHMS was completed in 2007 and feedlot beef in 2011; dairy cattle data was from 2002 and 2007; swine data were collected for 2006 and 2012, and the most recent poultry NAHMS was completed for 2010. The most recent data available had limited spatial resolution (compared to previous work [1], [2]), and so the model is only able to resolve large-scale regional differences in practices. For beef cow-calf systems, the United States was divided into four regions, but only two regions for beef housed on feedlots. For swine, the country was divided into three regions—Midwest, East, and South, and for layers, there were four regions—Northeast, Southeast, Central and West. An additional limitation in the data available for the characterization of the farm practices was that for some of the questions asked by the study, results were only reported in terms

of percent of operations which used a particular practice. This may give too much weight to the practices used on smaller farms which have a relatively small contribution to the overall level of ammonia emissions from a particular livestock type or practice. Thus, some uncertainty is expected as a result of the limited quantity of data available regarding manure management practices throughout the country.

As was previously discussed by Pinder et al. [3], one of the factors most limiting to the FEM's skill is the lack of information about manure management practices throughout the country. It is unclear whether these uncertainties result in the overprediction or underprediction of total ammonia emissions from livestock in the United States.

## Beef

Information regarding beef manure management practices was provided through the USDA National Animal Health Monitoring Study (NAHMS) with a regional distribution of practices. Beef data were provided for beef housed on feedlots as well as those that are a part of cow-calf systems. Cow-calf systems are those in which cattle are left on pasture or rangeland and the cows are kept with their calves, often until the calves are 1-2 years old and ready for sale. Feedlots are a much denser style of production in which large numbers of cattle are housed on concrete or packed earth lots and fed a mixture of corn and grains. Using the information from NAHMS and the animal numbers in the USDA 2012 agriculture census, the fraction of cattle in each state that were housed on feedlots as opposed those raised in a pasture-based farm system was discerned.

The distribution of manure management practices for the states included in the National Animal Health Monitoring System (NAHMS) (as split between feedlots and cow-calf systems) is based on literature [4]–[8]. The regional distribution of cattle on feed can be seen in the Figure 1 below. There have been relatively few studies that have characterized the emissions from cow-calf or pasture-based systems in the United States, especially compared to the emissions characterization that has been done at a variety of Texas and Oklahoma feedlots. The grazing portion of the beef farm emission model is therefore less constrained and may result in the underprediction of emissions of ammonia from beef not housed on feedlots.

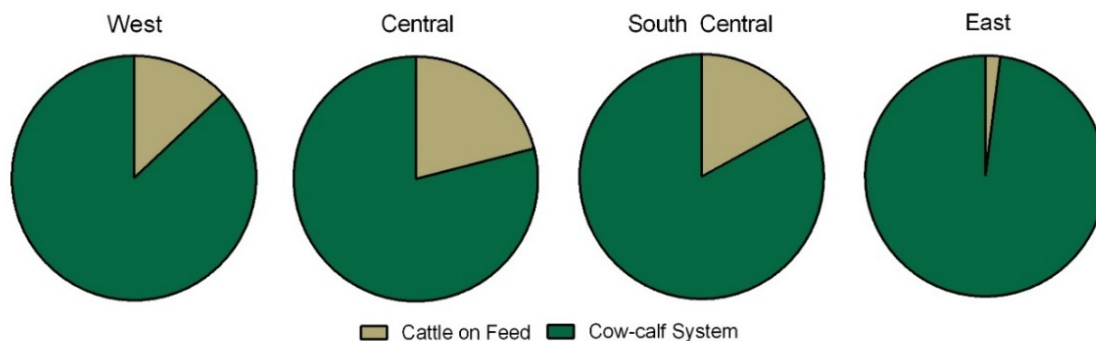


Figure 1. Regional distribution of beef cattle on feed. States in the West include: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. The states in the Central region are: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin. Texas and Oklahoma are in the South Central region. The remaining states are in the East.

Based on the information provided by NAHMS and the USDA Agricultural census, two manure management trains (MMTs) are considered. The first is an all grazing system where emissions are affected

by the rate of manure infiltration and directly exposed to the elements (temperature, windspeed, precipitation). The alternative is a feedlot system with solid manure storage and broadcast application.

## Dairy

The distribution of practices used in dairy cattle is unlikely to have changed substantially in the years following the work of Pinder et al. [1], [2], as seen when comparing the two most recent NAHMS results (from 2002 and 2007) to the 1996 NAHMS data used in the cited work. However, the data available for the 2002 and 2007 NAHMS was less regionally specific than was used in the previous work [9]–[13]. The manure management practice information received at that time included state-specific data, something not available for the current study years. Additionally, storage and application data for 2002 and 2007 was only available by fraction of surveyed operations rather than by population which may give too much weight to practices employed primarily at smaller dairy farms. Manure management practices can be described regionally as either in the West or East; the distribution of practices is shown below in Figure 2a-b.

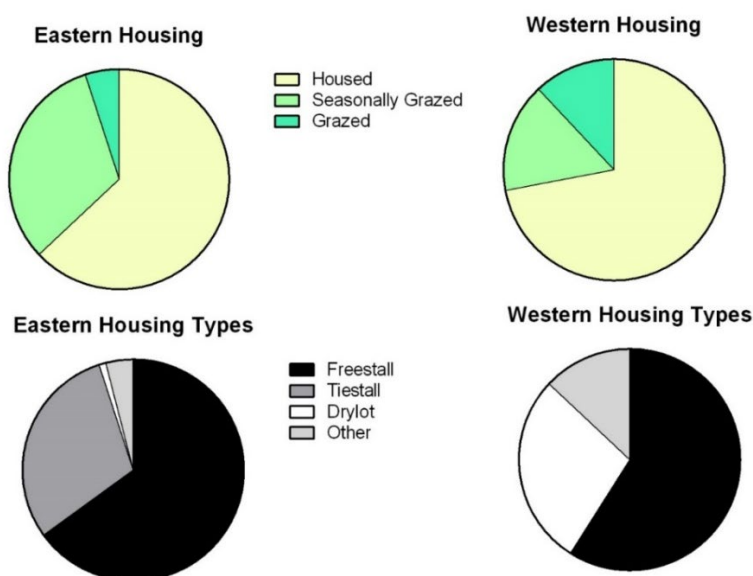


Figure 2a: Regional distribution of dairy housing practices from 2007 NAHMS for Eastern and Western United States. Eastern States include Minnesota, Iowa, Missouri, Arkansas, Louisiana and eastward. Western states are the rest of the continental US.

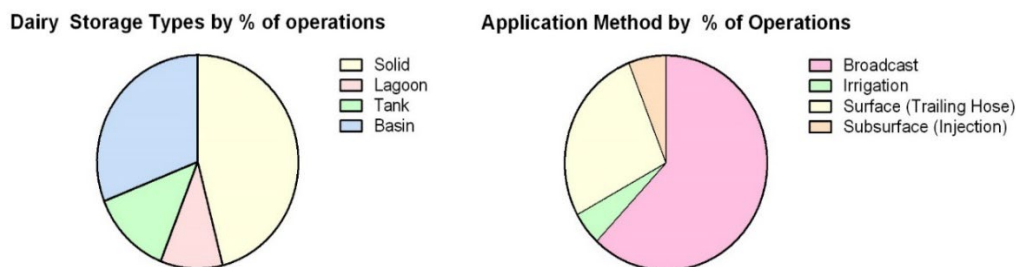


Figure 2b: Distribution of storage and application practices across the US. Regionally separated data was not available from the 2007 NAHMS, and results are presented in terms of percent of farming operations rather than percent of animal population, which may lead to over representation of minor practices.

## Swine

There is significant regional variability in the housing types and manure management practices (in terms of storage and application) for swine production in the United States. Some of the management choices made are the result of meteorological limitations (i.e. deep-pit versus shallow-pit housing) while others are chosen for economic reasons (less expensive to use irrigation application rather than injection).

Using the information provided by NAHMS, regional distributions of management practices can be described [14]–[17]. The United States can be broken into three regions based on this data: the South, the Midwest, and the East. Each of these groups of states has a unique distribution of housing, storage, and application practices, seen in Figure 3.

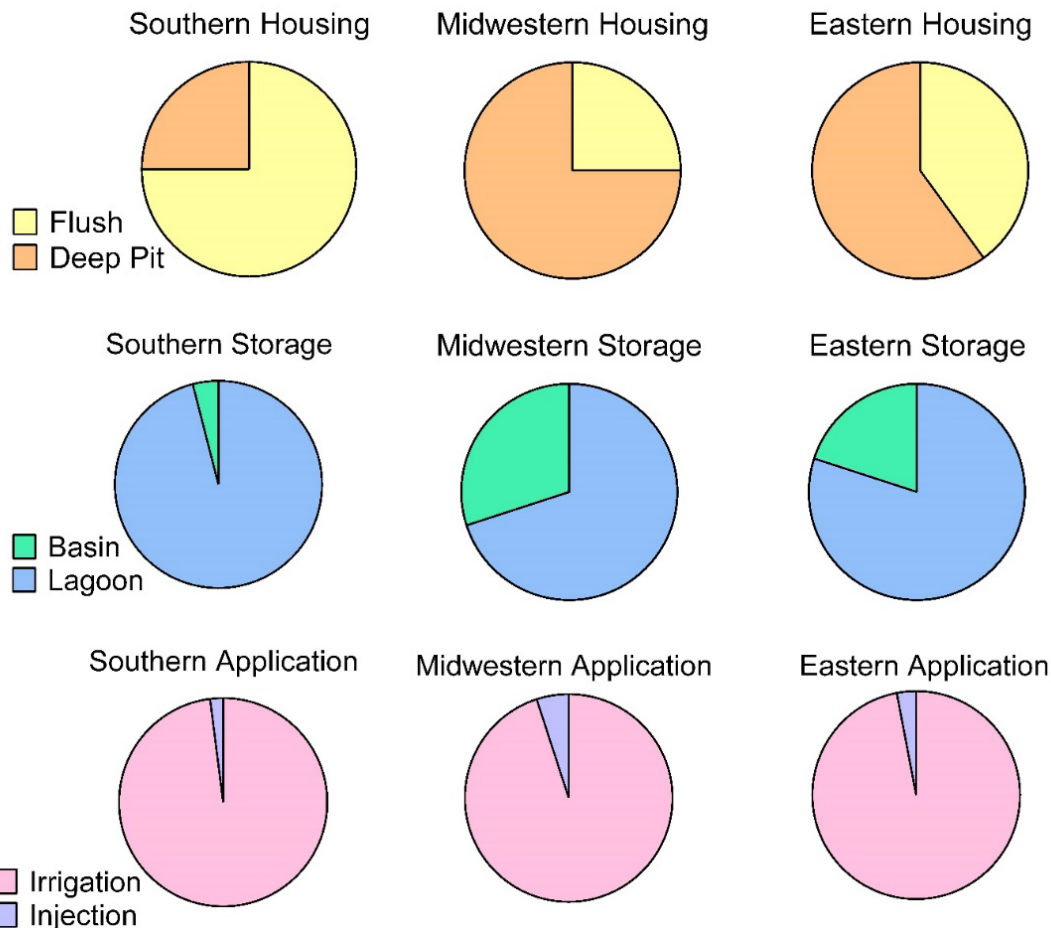


Figure 3: Regional Distribution of swine manure management practices. The Midwest includes: Idaho, Iowa, Minnesota, Montana, North Dakota, Nebraska, South Dakota, Wisconsin and Wyoming. The Eastern states include Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Vermont. The remainder of the states are included in the Southern region.

## Poultry

### Broilers

The major differences in broiler chicken production occur not in terms of farm type, but in the frequency with which barns are entirely cleaned out of their litter material; literature suggests that barns that are

cleaned out more frequently have lower emissions than those in which litter material is built up and reused [19]–[22]. Additional factors that may alter the emissions from these facilities include what the bedding or litter material is made up of as well as how long each barn stays empty between flocks. There is not sufficient data to include either bedding material or the time between flocks within the emissions inventory. In fact, much of the variability that might be caused by these factors on a single farm will likely be averaged out as a result of short lifecycle of these birds, which take less than two months to reach market size. Additionally, pasture-raised or organic practices are not included as they make up a very small fraction of total bird population and the emissions from these farms has not been characterized in the literature. The limited data available regarding manure storage and application from broiler housing may result in the underestimation of ammonia emissions from this animal type.

## Layers

There are two major housing types used in the production of layer chickens in the United States. These are high-rise layer houses and manure-belt layer houses. The chief difference between these two housing types is the frequency with which manure is removed; in high-rise barns, manure is removed 1-2 times each year, while manure is removed on a daily or weekly basis from manure-belt barns, which results in lower housing emissions and ammonia concentrations but leaves greater quantities in the manure that is headed toward storage and application or processing. High-rise housing operations are more prevalent than manure-belt houses throughout the United States (Figure 4), but manure-belt are somewhat more common in the western and central portions of the United States. There are some limitations on the ability of the FEM for both the storage and application of poultry manure as there have been few studies to characterize these emissions. The majority of ammonia emissions from poultry are expected to be from housing (particularly for high-rise facilities).

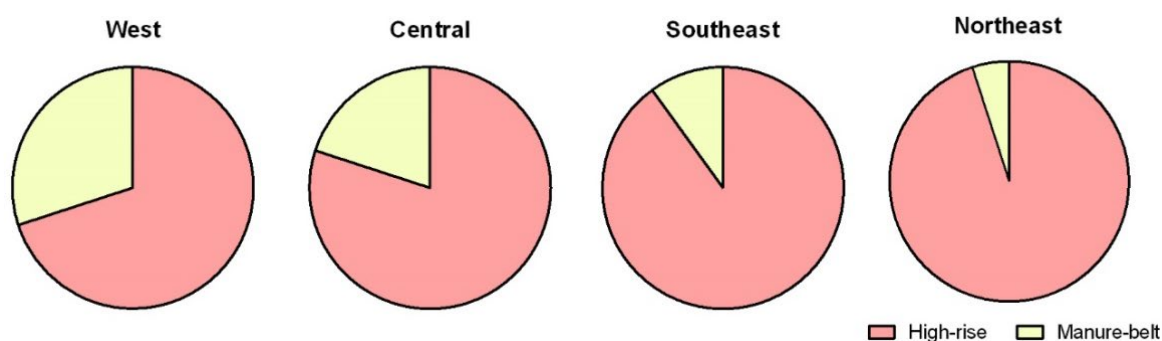


Figure 4. Regional distribution of layer housing types. The West includes: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. The Central states are: Arkansas, Illinois, Indiana, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Southeastern states are: Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia. The remaining states are considered to be in the Northeast.

Additionally, the most recent NAHMS information does not capture the more recent trend towards cage-free housing or pasture-raised layer chickens [23]–[25]. Cage-free housing is a relatively minor housing practice currently (<10% of all layer chickens are raised on cage free farms, but state-specific data is unavailable so this may vary significantly by state, and this may not represent a similar fraction of total eggs produced), but is poised to grow as a result of concerns about animal health and welfare and the demand for cage-free eggs increases. According to the most recently completed NAHMS, cage-free production occurs at approximately 3% of large layer operations (more than 100,000 layers), and

approximately one-quarter of smaller farms. The data provided by NAHMS does not specify the fractions of total layer populations raised at particular farm sizes, but large farms have become increasingly common and it is expected that most eggs are produced from larger farms [25]. Cage-free and organic products are more likely to come from smaller farms whose emissions have not been well-characterized in the literature. Cage-free production is more common in Europe than the United States, so emissions studies from Europe could be used to better characterize cage-free housing emissions [26]–[28].

## **Model Parameters**

The FEM is a tuned-model that applies adjustments to approximate observed data. However, the model evaluation does not reflect the ability of the FEM to predict completely independent measurements but the ability of a relatively simple process-based model, with a single set of mass transfer parameters for each manure management practice, to describe the full range of observed variability.

The NAEMS data and literature data are displayed in Figure 5 below. The range of temperatures studied is most extended for layer hens. With the additional NAEMS data, an apparent inverse relationship between temperature and ammonia emissions is observed, something that was not clear in the prior literature. It has been suggested that this inverse relationship (higher emissions factors for lower temperatures) is related to the drying out of manure in hot barns with high ventilation rates [30]. At lower temperatures, barn ventilation is reduced (to conserve heat) and manure dries slowly, and, therefore more manure urea can be broken down into ammonia, which is then available for volatilization. Additionally, for some practices, particularly for swine storage, emissions factors from NAEMS were uniformly higher than those previously reported in the literature, for both high and low temperatures. As a result of these differences, the FEM's tuned parameters were adjusted so that model emission factors fell between NAEMS and literature data, weighting the literature studies equally with the NAEMS observations so as not to over-tune to only the literature or NAEMS data. There is significant value in both previously published studies as well as in the values reported by NAEMS, so the re-tuning done is to ensure that this work takes advantage of all available data.

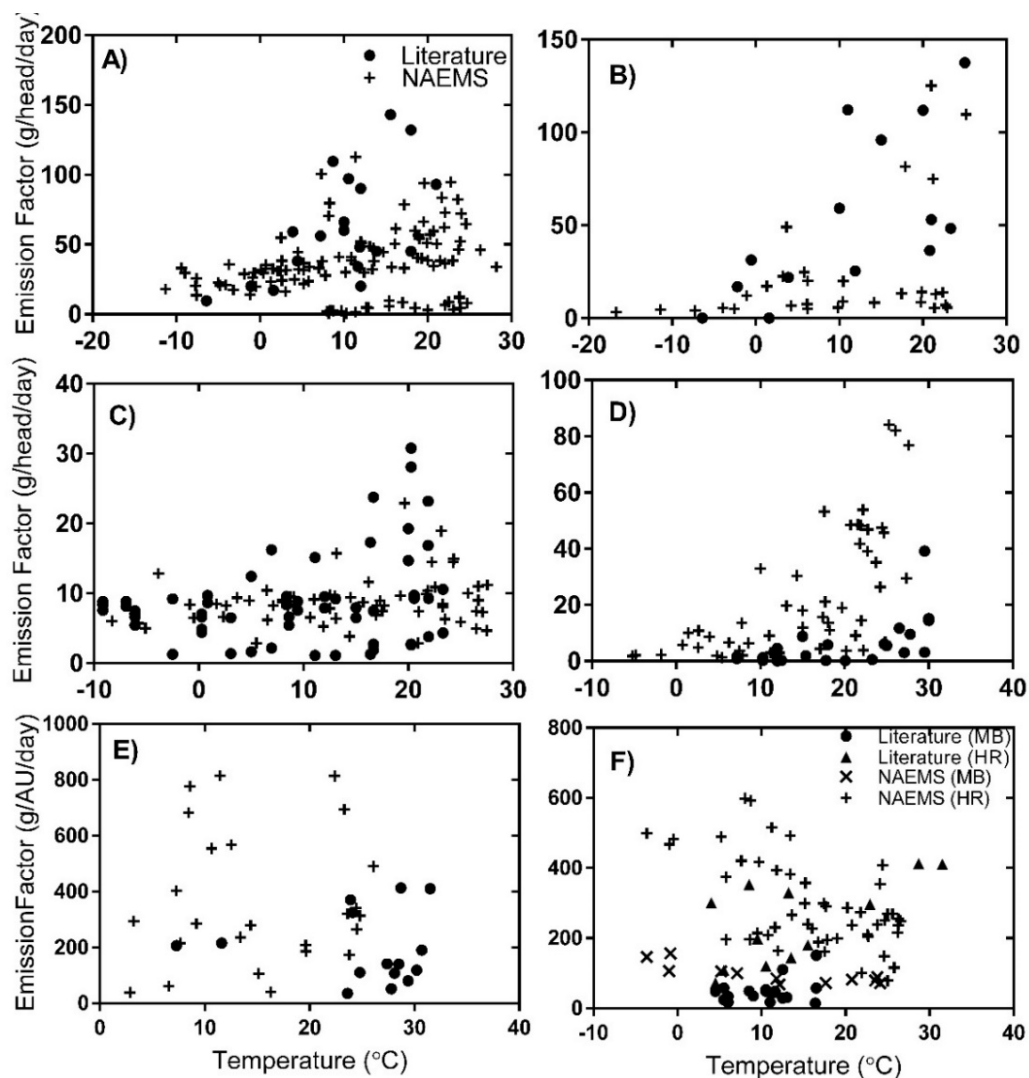


Figure 5: Emission factors as a function of temperature reported in the prior literature and from the National Air Emissions Monitoring Study (NAEMS). Results are displayed by animal type and management stage as follows: a) free-stall dairy housing emissions, b) dairy lagoon storage emissions, c) deep-pit and flush-type swine housing emissions, d) swine lagoon and basin storage emissions, e) litter-based broiler housing emissions, and f) manure-belt (MB) and high-rise (HR) layer housing emissions. (1 AU = animal unit = 500 kg live animal weight)

### Manure characteristics

Manure characteristics are important input parameters to the model because they govern the amount of nitrogen available for emission, whether or not the nitrogen present is likely to be volatilized, and how well the waste can infiltrate into the soil during manure application. These parameters have been selected based on information extracted from published literature as well as reports from the National Air Emissions Monitoring study. Table 3 describes the types of parameters and inputs critical to the model and Table 4 presents information about manure volume, nitrogen concentration and pH levels in the waste from each type of animal included in the model.

**Table 3.** Description and sources of model inputs and parameters

Data Type	Description	Source of input or parameter	Input or Tuned Parameter?
-----------	-------------	------------------------------	---------------------------

Meteorology	Temperature (°C) Wind speed (m/s) Precipitation	From National Climate Data Center, based on farm location	Input value (monthly average for seasonal emissions, daily values for daily model run)
Manure Management Practice	Type of housing, storage, or application	Unique to each farm type; farm types have a unique set of inputs	Input value
Resistance Parameters	Surface mass transfer resistance from manure to atmosphere	Tuned based on literature and NAEMS observations to agree with previous work; constant for a particular management practice (for a particular animal type)	Tuned Parameters

**Table 4. Model Input parameters related to manure characteristics**

Parameter Name	Animal Type	Range of Values	Value Used in Model	Units	Source
Manure Volume	Beef	12-17	15	l animal <sup>-1</sup> day <sup>-1</sup>	[2], [31]
	Dairy			l animal <sup>-1</sup> day <sup>-1</sup>	[2]
	Swine	4-10	6	l animal <sup>-1</sup> day <sup>-1</sup>	[32]
	Poultry-Layer	0.088	0.088	l animal <sup>-1</sup> day <sup>-1</sup>	[33], [34]
	Poultry-Broiler	4.9	4.9	l finished animal <sup>-1</sup>	[33]
Manure Urea Concentration	Beef	47-70		kg N animal <sup>-1</sup> year <sup>-1</sup>	[33]
	Dairy			kg N animal <sup>-1</sup> year <sup>-1</sup>	[2]
	Swine	11-35		kg N animal <sup>-1</sup> year <sup>-1</sup>	[34], [35]
	Poultry-Layer	0.5-0.6	0.55	kg N animal <sup>-1</sup> year <sup>-1</sup>	[33]
	Poultry-Broiler	0.05-0.06	0.055	kg N finished animal <sup>-1</sup>	[33]
Housing pH	Beef	7.7	7.7		[36]
	Dairy	7.5-8.3	7.7		[2]
	Swine	6.5-7.5	7		[37]
	Poultry-Layer	7.1-7.6 (MB); 8.4-8.7	7.3		[38],[39]
	Poultry-Broiler	8	8		[40]
Storage pH	Dairy	7.0-8.0	7.5		[1]
	Swine	7.5-8	7.7		[35]
Application pH	Beef	7.5	7.5		[41]
	Dairy	7.0-7.7	7.3		[2]
	Swine	7.8-8.2	8		[42]
	Poultry-Layer	7.2	7.2		[43]
	Poultry-Broiler	8.8	8.8		[44]
Storage pH	Beef	7.7	7.7		[2]
	Dairy	7.5-8.3	7.7		[2]

There are a limited number of studies which describe the manure nitrogen and manure pH for each animal type. As a result there is considerable uncertainty in these input values which can result in significant uncertainty in predicted emissions from the model.

### Tunable parameters

The FEM is a balance between an empirical approach and first-principles process-based model. A nitrogen mass balance and a process description of ammonia losses are used, but the FEM model parameters are tuned to reproduce measured emissions factors. Model complexity is limited to the most important emissions processes and to inputs that are typically available. The strategy pursued for developing process-based models is guided by the need to build emissions inventories, and the requirements and data limitations associated with this application. Previous measurement campaigns also

often sampled emissions from a single part of the production process. This means that information about the emissions process from the start to end of production might be lacking, making nitrogen mass balance in the system difficult. The lack of whole-farm measurements is one gap in much of the literature available and a benefit of the estimates of ammonia emissions produced by the FEM.

There are 2-3 tunable parameters associated with each submodel in the farm emissions model. These tunable parameters allow adjustment of model-predicted emissions and to correct for the unknowns and uncertainties of the input parameters and to ensure that the model-predicted values are consistent with those that have been reported in the literature and in the National Air Emissions monitoring study; they are constant for a particular farm type—tuning is not done for a particular farm—and as a result, there can be significant disagreement between model predictions and the measured emissions for a single farm. The goal of the FEM is not necessarily to capture the emissions of single farms perfectly, but rather to capture the effects of various parameters on emissions on a farm typical of a certain set of practices.

In the FEM, as previously described [29], [45], [46], ammonia emissions are estimated as a function of the nitrogen present in the waste and the mass transfer resistance. This resistance is made up of the following three parts: the aerodynamic ( $r_a$ ), quasi-laminar ( $r_b$ ), and surface resistances ( $r_s$ ) [47]. Aerodynamic and quasi-laminar resistances are used to describe the resistance to transport in the gaseous layer above the animal wastes [45], [48], [49]. These parameters are based on widely used theoretical formulas and are not tuned. The third part of the resistance is the surface resistance from diffusion closest to the gas-liquid (manure) interface. Here, the surface resistance is a function of tuned parameters as well as temperature which ensures the modeled ammonia emission factors are consistent with observations; Table 5 lists which tunable parameters are used for each animal and each submodel.

These values are specific to a particular practice for a particular animal type. This means that a free stall dairy with lagoon storage and injection application would employ the same tuned parameters whether it was located in New York or California. Conversely, two farms in the same location but utilizing different manure management practices would have different tuned parameters in their submodels. The values that have been used for each of these parameters can be found in Table 6.

**Table 5. Tuned model parameters for beef, swine, and poultry**

Submodel	Animal Type	Description	Tuning/Evaluation Sources
Housing	Cattle: Beef & Dairy Swine Poultry: Broiler & Layer	Resistance parameters $H_1$ , $H_2$	[50]–[67], [68]–[72], [73]–[78], [79]–[84]
Storage	Dairy Cattle Swine	Resistance parameters $S_1$ , $S_2$	[85]–[90]
Application	Cattle: Beef & Dairy Swine Poultry: Broiler & Layer	Resistance parameters $A_1$ , $A_2$ , $A_3$	[91], [92], [93]–[95], [96], [97]
Grazing	Cattle: Dairy & Beef	Resistance parameters $G_1$ , $G_2$	[98]

**Table 6. Tuned Parameter Values by practice and animal type**

Submodel	Animal Type	Description	Parameter Values
Housing	Beef cattle	Beef Feedlot	$H_1=0.1 \text{ (s}\cdot\text{m}^{-1}\cdot\text{°C}^{-1})$ , $H_2=-0.01 \text{ (s}^2\text{m}^{-2})$
	Swine	Swine—shallow pit	$H_1=0.08 \text{ (s}\cdot\text{m}^{-1})$ , $H_2=-0.004 \text{ (s}\cdot\text{m}^{-1}\cdot\text{°C}^{-1})$
		Swine—deep pit	$H_1=0.1 \text{ (s}\cdot\text{m}^{-1})$ , $H_2=-0.008 \text{ (s}\cdot\text{m}^{-1}\cdot\text{°C}^{-1})$

	Poultry-Layer	Layer—Manure belt	H <sub>1</sub> =0.3(s•m <sup>-1</sup> ), H <sub>2</sub> =-0.015(s•m <sup>-1</sup> •°C <sup>-1</sup> )
		Layer—High Rise	H <sub>1</sub> =0.22(s•m <sup>-1</sup> ), H <sub>2</sub> =-0.02(s•m <sup>-1</sup> •°C <sup>-1</sup> )
	Poultry-Broiler	Broiler	H <sub>1</sub> =0.15(s•m <sup>-1</sup> ), H <sub>2</sub> =-0.035(s•m <sup>-1</sup> •°C <sup>-1</sup> )
Storage	Swine	Swine lagoon	S <sub>1</sub> =0.20(s•m <sup>-1</sup> ), S <sub>2</sub> =4.00(s•m <sup>-1</sup> •°C <sup>-1</sup> )
		Swine basin	S <sub>1</sub> =0.11(s•m <sup>-1</sup> ), S <sub>2</sub> =2.24(s•m <sup>-1</sup> •°C <sup>-1</sup> )
Application	Beef cattle	Beef—broadcast	A <sub>1</sub> =0.0004, (s•m <sup>-1</sup> )A <sub>2</sub> =0.88, A <sub>3</sub> =-1.4
	Swine	Swine—irrigation	A <sub>1</sub> =0.001(s•m <sup>-1</sup> ), A <sub>2</sub> =-10, A <sub>3</sub> =20
		Swine—injection	A <sub>1</sub> =0.01(s•m <sup>-1</sup> ), A <sub>2</sub> =-15, A <sub>3</sub> =40
Grazing	Beef Cattle	Beef Pasture	G <sub>1</sub> = 0.12(s•m <sup>-1</sup> ), G <sub>2</sub> =5.4

## F. Controls

There are no controls assumed for this category.

## G. Emissions

### *Back Calculating the 2014 NH<sub>3</sub> Emissions Factors from the CMU Model*

The emissions estimates in NEI 2014 v1 came from the CMU model. These emissions were then divided by the model's animal population figures to estimate the statewide NH<sub>3</sub> emission factor.

$$EF_{s,a,2014} = E_{s,a,2014} \div A_{s,a,2014} \quad (2)$$

Where:

$EF_{s,a,2014}$  = 2014 NH<sub>3</sub> emissions factor from the CMU model for animal type  $a$  and state  $s$  (kg/head)

$E_{s,a,2014}$  = 2014 NH<sub>3</sub> emissions from the CMU model for animal type  $a$  and state  $s$  (kg)

$A_{s,a,2014}$  = 2014 animal count for animal type  $a$  and state  $s$  (head)

### *Calculating the 2017 NH<sub>3</sub> Emissions Factors*

The 2017 NH<sub>3</sub> emissions factors are estimated by multiplying the NH<sub>3</sub> emissions factors from the 2014 NEI CMU model run with the ratio of the 2017 to 2014 CMU model runs performed with the updated hourly metrological data.

$$EF_{s,a,2017} = EF_{s,a,2014} \times EF_{CMU,s,a,2017} \div EF_{CMU,s,a,2014} \quad (3)$$

Where:

$EF_{s,a,2017}$  = 2017 NH<sub>3</sub> emissions factor for animal type  $a$  and state  $s$  (kg/head)

$EF_{s,a,2014}$  = 2014 NH<sub>3</sub> emissions factor from the 2014 NEI CMU model run for animal type  $a$  and state  $s$  (kg/head)

$EF_{CMU,s,a,2017}$  = 2017 NH<sub>3</sub> emissions factor from the 2017 CMU model run for animal type  $a$  and state  $s$  (kg/head)

$EF_{CMU,s,a,2014}$  = 2014 NH<sub>3</sub> emissions factor from the updated 2014 CMU model run for animal type  $a$  and state  $s$  (kg/head)

### *Calculating 2017NH<sub>3</sub> Emissions due to Livestock*

Emissions are calculated by multiplying the state specific NH<sub>3</sub> emission factor (in NH<sub>3</sub>/head) by the number of animals in a given county in that state.

$$E_{c,a,2017} = EF_{s,a,2017} \times A_{c,a,2017} \times 2.2/2000 \quad (4)$$

Where:

$E_{c,a,2017}$  = 2017 NH<sub>3</sub> emissions for animal type  $a$  and county  $c$  (ton)

$EF_{s,a,2017}$  = 2017 NH<sub>3</sub> emissions factor for animal type  $a$  and state  $s$  in which the county is located (kg/head)

$A_{c,a,2017}$  = 2017 animal count for animal type  $a$  and state  $s$  (head)

2.2/2000 = conversion factor from kg to tons

### *Calculating 2017 VOC Emissions due to Livestock*

VOC emissions are calculated using the ratio of VOC to NH<sub>3</sub> emissions from livestock. That ratio is 0.08 kg of VOC for every kg of NH<sub>3</sub>.

$$E_{VOC,c,a,2017} = VOC/NH_3 \times E_{c,a,2017} \quad (5)$$

Where:

$E_{VOC,c,a,2017}$  = 2017 VOC emissions for animal type  $a$  and county  $c$  (ton)

$VOC/NH_3$  = 0.08

$E_{c,a,2017}$  = 2017 NH<sub>3</sub> emissions for animal type  $a$  and county  $c$  (ton)

### *Calculating 2017 HAP Emissions due to Livestock*

HAP emissions are calculated using the ratio of HAP to VOC emissions from livestock. These ratios are derived from the SPECIATE database as discussed above in Section E.

$$E_{HAP,c,a,2017} = \frac{HAP}{VOC} \times E_{VOC,c,a,2017} \times 2000 \quad (6)$$

Where:

$E_{HAP,c,a,2017}$  = 2017 HAP emissions for animal type  $a$  and county  $c$  (lb)

$HAP/VOC$  = speciation factor derived from the SPECIATE database and listed in Table 2

$E_{VOC,c,a,2017}$  = 2017 VOC emissions for animal type  $a$  and county  $c$  (ton)

2000 = conversion factor from tons to pounds

### *Alaska and Hawaii*

The CMU model does not cover Alaska or Hawaii (only the lower 48 states); however, the animal counts database does have values for Alaska and Hawaii. To estimate NH<sub>3</sub> (and other pollutant) emissions for Alaska and Hawaii, the state-level emissions factors from Idaho were used as a surrogate for Alaska and state-level emissions factors from Florida were used as a surrogate for Hawaii.

## H. Point Source Subtraction

There are no point source-specific SCCs for livestock; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 7 lists sample calculations to determine NH<sub>3</sub>, VOC and Toluene emissions from swine production in Cochise County, Arizona.

**Table 7. Sample Calculations for NH<sub>3</sub>, VOC and Toluene emissions from swine in Cochise County, AZ.**

Eq. #	Equation	Values for Cochise County, AZ	Result
2	$\begin{aligned} EF_{s,a,2014} \\ &= E_{s,a,2014} \\ &\div A_{s,a,2014} \end{aligned}$	$= 9,370 \text{ kg } NH_3 \div 925 \text{ swine}$	10.13 kg NH <sub>3</sub> per head of swine in Cochise County in 2014
3	$\begin{aligned} EF_{s,a,2017} \\ &= EF_{s,a,2014} \\ &\times EF_{CMU,s,a,2017} \\ &\div EF_{CMU,s,a,2014} \end{aligned}$	$= 10.13 \text{ kg } NH_3 \text{ per swine} \times 1.019159$	10.32 kg NH <sub>3</sub> per head of swine in Cochise County in 2017
4	$\begin{aligned} E_{c,a,2017} \\ &= EF_{s,a,2017} \\ &\times A_{c,a,2017} \\ &\times 2.2/2000 \end{aligned}$	$= 10.32 \text{ kg } NH_3 \times 30,693 \text{ swine} \times 2.2 / 2000$	348.6 tons of NH <sub>3</sub> emissions from swine in Cochise County in 2017
5	$\begin{aligned} E_{VOC,c,a,2017} \\ &= VOC/NH_3 \\ &\times E_{c,a,2017} \end{aligned}$	$= 0.08 \times 348.6 \text{ tons of } NH_3$	27.89 tons of VOC emissions from swine in Cochise County in 2017
6	$\begin{aligned} E_{HAP,c,a,2017} \\ &= \frac{HAP}{VOC} \\ &\times E_{VOC,c,a,2017} \\ &\times 2000 \end{aligned}$	$= 0.0047 \times 27.89 \text{ tons } VOC \times 2000$	262.1 lb of toluene from swine in Cochise County in 2017

## **J. Changes from 2014 Methodology**

The methodology for estimating county-level animal counts is based on the U.S. EPA's Greenhouse Gas Inventory. This data set is derived from multiple data sets from the United States Department of Agriculture (USDA), particularly the National Agricultural Statistics Service (NASS) survey and census. In addition, the NH<sub>3</sub> emissions factors were updated to 2017 by growing 2014 emissions factors based on the ratio of 2017 to 2014 emission rates from CMU model runs with updated 2014 and 2017 hourly meteorological data from NOAA.

## **K. Puerto Rico and U.S. Virgin Islands Emissions Calculations**

Due to the lack of animal counts in Puerto Rico and the U.S. Virgin Islands, emissions are not estimated for these territories.

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# 2017 Nonpoint Oil and Gas Emission Estimation Tool Version 1

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## **1.0 INTRODUCTION**

### **1.1 The National Emissions Inventory (NEI)**

The U.S. Environmental Protection Agency's (EPA) Emission Inventory and Analysis Group (EIAG) produces the National Emission Inventory (NEI) for criteria and hazardous air pollutants (HAPs) every three years. The NEI is a comprehensive and detailed estimate of air emissions of both criteria and HAP from all air emissions sources, including both stationary (e.g. power plants and petroleum refineries) and mobile (e.g. automobiles and aircraft) sources. The NEI is prepared by the U.S. EPA based primarily upon emission estimates and emission model inputs provided by State, Local, and Tribal air agencies for sources in their jurisdictions, and supplemented by data developed by the U.S. EPA. These data are needed for a variety of reasons, including modeling demonstrations, regulatory analyses, and to produce the National Air Pollutant Emission Trends report.

Emissions from stationary sources can be divided into two sectors: point sources and nonpoint sources (nonpoint sources are sometimes referred to as area sources). The NEI point sources emissions inventory contains emissions estimates for sources that are individually inventoried and usually located at a fixed, stationary location, although portable sources such as some asphalt or rock crushing operations are also included. Point sources include large industrial facilities and electric power plants, but also increasingly include many smaller industrial and commercial facilities, such as dry cleaners and gas stations, which have traditionally been included as nonpoint sources.

The NEI nonpoint sources emissions inventory includes emission sources which individually are too small in magnitude or too numerous to inventory as individual point sources, and which can often be estimated more accurately as a single aggregate source for a County or Tribal area. Examples of nonpoint source categories are residential heating and consumer solvent use.

The 2017 NEI is currently being developed and will utilize the emission estimates generated by the 2017 Nonpoint Oil and Gas Emission Estimation Tool (the "tool") as described in Section 1.2. For historical reference, the 2011 and 2014 NEI and supporting documentation is available on-line at <https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei>.

### **1.2 Nonpoint Oil and Gas Emission Estimation Tool**

Nonpoint source emissions from the oil and gas exploration and production sector have gained interest in recent years in the United States as drilling technology has allowed development of unconventional oil and gas plays in areas where there was previously no activity, or where activity had subsided after depletion of the conventional reserves. For example, the areas in and around the Barnett, Haynesville, and Eagle Ford Shales in Texas; the Marcellus Shale in Ohio, Pennsylvania, and West Virginia; and the Bakken Shale/Williston Basin in North Dakota and Montana have all experienced a rapid expansion in activity over the last ten years.

## ***Nonpoint Oil and Gas Emissions Estimation Tool***

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These are referred to as “unconventional” oil and gas plays as the resource must be stimulated through high-pressure, high-volume hydraulic fracturing to release the oil and gas trapped in the source formation (such as shale or tight sands). In this tool, these types of wells are assumed to be have been hydraulically fractured when completed, and emissions from the hydraulic fracturing pump engines are included as a discrete source type (see Section 3.11).

While the major emissions sources associated with oil and gas collection, processing, and distribution have traditionally been included in the NEI as point sources (e.g. gas processing plants, pipeline compressor stations, and refineries), the activities occurring “upstream” of these types of facilities have not been as well characterized in the NEI. In this report, upstream activities refer to emission units and processes associated with the exploration and drilling of oil and gas wells, and the equipment used at the wellsite to then extract the product from the well and deliver it “downstream” to a central collection point or processing facility. The types of unit processes found at upstream sites include separators, dehydrators, storage tanks, and compressor engines.

The NEI nonpoint oil and gas emissions inventory is primarily developed using data supplied to EPA by state air agencies. Where state data is not supplied to EPA, EPA populates the NEI with the best available data. In the case of nonpoint oil and gas emissions estimates, EPA has developed the tool described in this report to estimate emissions from this category. The tool is an Access database that utilizes county-level activity data (e.g. oil production and well counts), operational characteristics (types and sizes of equipment), and emission factors to estimate emissions.

The emission estimates generated by the tool are only used in the NEI if state data is not available. Where state data is available but does not include HAP, EPA estimates HAPs based on their ratios to VOC or PM in gas composition profiles and adds them to the NEI. The HAP augmentation procedure is described in detail in the documentation for the 2014 NEI (<https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data>).

This report describes the technical approach used to develop the tool to characterize emissions from nonpoint oil and gas exploration and production sources for the year 2017. The tool generates estimates of emissions of oxides of nitrogen (NO<sub>x</sub>), volatile organic compounds (VOC), particulate matter (PM), carbon monoxide (CO), ammonia (NH<sub>3</sub>), sulfur dioxide (SO<sub>2</sub>), HAPs, and hydrogen sulfide (H<sub>2</sub>S) from upstream oil and gas production activities. Specific source categories included in the tool are:

- Artificial Lift Engines
- Associated Gas Venting
- Coalbed Methane Dewatering Pump Engines
- Condensate Tanks
- Crude Oil Tanks
- Dehydrators
- Drilling Rigs

### ***Nonpoint Oil and Gas Emissions Estimation Tool***

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- Fugitive Emissions
- Gas-Actuated Pneumatic Pumps
- Heaters
- Hydraulic Fracturing Pumps
- Lateral Compressor Engines
- Liquids Unloading
- Hydrocarbon Liquids Loading
- Mud Degassing
- Pneumatic Devices
- Produced Water Tanks
- Well Completion Venting
- Wellhead Compressor Engines
- Flaring (when used to control emissions from the unit processes listed above)

Many of the source categories covered by the tool are further sub-divided into distinct source classification codes (SCCs) specific to either a well type (gas or oil), a sub-category of the broader equipment type (such as fugitive emissions from connectors and fugitive emissions from valves), or some other distinction. Table 1-1 presents a complete listing of the SCCs covered by the tool for each of the source categories listed above.

**Table 1-1. SCC Listing**

Source Category	SCC	SCC Description
Artificial Lift Engines	2310011600	Oil and Gas: Onshore Oil Production/Artificial Lift Engines
Associated Gas Venting	2310011001	Oil and Gas: Onshore Oil Production/Associated Gas Venting
CBM Dewatering Pump Engines	2310023000	Coal Bed Methane NG/Dewatering Pump Engines
Condensate Tanks	2310021010	On-Shore Gas Production /Storage Tanks: Condensate
Condensate Tanks	2310023010	On-Shore CBM Production /Storage Tanks: Condensate
Crude Oil Tanks	2310010200	Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Tanks - Flashing & Standing/Working/Breathing
Dehydrators	2310021400	On-Shore Gas Production Dehydrators
Dehydrators	2310023400	Coal Bed Methane NG / Dehydrators
Drilling Rigs	2310000220	Oil And Gas Exploration Drill Rigs
Fugitive Emissions	2310011501	On-Shore Oil Production /Fugitives: Connectors
Fugitive Emissions	2310011502	On-Shore Oil Production /Fugitives: Flanges
Fugitive Emissions	2310011503	On-Shore Oil Production /Fugitives: Open Ended Lines
Fugitive Emissions	2310011505	On-Shore Oil Production /Fugitives: Valves

**Table 1-1. SCC Listing**

Source Category	SCC	SCC Description
Fugitive Emissions	2310021501	On-Shore Gas Production /Fugitives: Connectors
Fugitive Emissions	2310021502	On-Shore Gas Production /Fugitives: Flanges
Fugitive Emissions	2310021503	On-Shore Gas Production /Fugitives: Open Ended Lines
Fugitive Emissions	2310021505	On-Shore Gas Production /Fugitives: Valves
Fugitive Emissions	2310021506	On-Shore Gas Production /Fugitives: Other
Fugitive Emissions	2310023511	On-Shore CBM Production /Fugitives: Connectors
Fugitive Emissions	2310023512	On-Shore CBM Production /Fugitives: Flanges
Fugitive Emissions	2310023513	On-Shore CBM Production /Fugitives: Open Ended Lines
Fugitive Emissions	2310023515	On-Shore CBM Production /Fugitives: Valves
Fugitive Emissions	2310023516	On-Shore CBM Production /Fugitives: Other
Gas-Actuated Pumps	2310023310	Coal Bed Methane NG / Pneumatic Pumps
Gas-Actuated Pumps	2310111401	On-Shore Oil Exploration /Oil Well Pneumatic Pumps
Gas-Actuated Pumps	2310121401	On-Shore Gas Exploration: Gas Well Pneumatic Pumps
Heaters	2310010100	On-Shore Oil Production /Heater Treater
Heaters	2310021100	On-Shore Gas Production /Gas Well Heaters
Heaters	2310023100	On-Shore CBM Production /CBM Well Heaters
Hydraulic Fracturing Pumps	2310000660	Oil & Gas Expl & Prod /All Processes /Hydraulic Fracturing Engines
Hydrocarbon Liquids Loading	2310011201	On-Shore Oil Production /Tank Truck/Railcar Loading: Crude Oil
Hydrocarbon Liquids Loading	2310021030	On-Shore Gas Production /Tank Truck/Railcar Loading: Condensate
Hydrocarbon Liquids Loading	2310023030	On-Shore CBM Production /Tank Truck/Railcar Loading: Condensate
Lateral Compressor Engines	2310021251	On-Shore Gas Production/Lateral Compressors 4 Cycle Lean Burn
Lateral Compressor Engines	2310021351	On-Shore Gas Production/Lateral Compressors 4 Cycle Rich Burn
Lateral Compressor Engines	2310023251	On-Shore CBM Production/Lateral Compressors 4 Cycle Lean Burn
Lateral Compressor Engines	2310023351	On-Shore CBM Production/Lateral Compressors 4 Cycle Rich Burn
Liquids Unloading	2310021603	On-Shore Gas Production / Gas Well Venting - Blowdowns
Liquids Unloading	2310023603	On-Shore CBM Production / CBM Well Venting - Blowdowns

**Table 1-1. SCC Listing**

Source Category	SCC	SCC Description
Mud Degassing	2310023606	On-Shore CBM Exploration /Mud Degassing
Mud Degassing	2310111100	On-Shore Oil Exploration /Mud Degassing
Mud Degassing	2310121100	On-Shore Gas Exploration /Mud Degassing
Pneumatic Devices	2310010300	Oil Production Pneumatic Devices
Pneumatic Devices	2310021300	On-Shore Gas Production Pneumatic Devices
Pneumatic Devices	2310023300	On-Shore CBM Production Pneumatic Devices
Produced Water Tanks	2310000551	Produced Water from CBM Wells
Produced Water Tanks	2310000552	Produced Water from Gas Wells
Produced Water Tanks	2310000553	Produced Water from Oil Wells
Well Completion Venting	2310023600	On-Shore CBM Exploration: CBM Well Completion: All Processes
Well Completion Venting	2310111700	On-Shore Oil Exploration: Oil Well Completion: All Processes
Well Completion Venting	2310121700	On-Shore Gas Exploration: Gas Well Completion: All Processes
Wellhead Compressor Engines	2310021102	On-Shore Gas Production /Natural Gas Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
Wellhead Compressor Engines	2310021202	On-Shore Gas Production /Natural Gas Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
Wellhead Compressor Engines	2310021302	On-Shore Gas Production /Natural Gas Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP
Wellhead Compressor Engines	2310023102	On-Shore CBM Production /CBM Fired 2Cycle Lean Burn Compressor Engines 50 To 499 HP
Wellhead Compressor Engines	2310023202	On-Shore CBM Production /CBM Fired 4Cycle Lean Burn Compressor Engines 50 To 499 HP
Wellhead Compressor Engines	2310023302	On-Shore CBM Production /CBM Fired 4Cycle Rich Burn Compressor Engines 50 To 499 HP

It should be noted that these source categories do not represent a complete list of all emission sources or SCCs that may be found at upstream oil and gas exploration and production sites. However, the most significant nonpoint sources that contribute to emissions have been included. Sources that were not included due to limited data availability include: salt water injection engines, well pad construction equipment, workover equipment, and mobile sources. Associated on-road mobile sources operating in the field, such as service vehicles used during construction, drilling and production phases, may be included in some states' mobile source emissions inventories but are not specifically included in the tool.

## ***Nonpoint Oil and Gas Emissions Estimation Tool***

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ERG developed the tool initially under EPA Contract No. EP-D-11-006, Work Assignment (WA) 2-05, followed on by subsequent WAs and this Task Order (TO). The purpose/objectives of the WAs/TO were the following:

- 1) Develop a nonpoint methodology to estimate county-level emissions of criteria pollutants and HAP for the upstream oil and gas production sector for 2011, 2014, and 2017;
- 2) Implement the methodology to develop county-level emissions inventories for this sector; and
- 3) Develop a MS Access-based tool incorporating the methodologies and available information that may be used by EPA, states, and local agencies to develop state or region-specific emission inventories for the upstream oil and gas sector based on user supplied activity and emissions inputs.

The following describes how the information in this report is organized:

Section 2 – background information on development of tool

Section 3 – information on the methodology and emission estimation approach used for each source category

Section 4 – summary of nonpoint oil and gas emission estimates generated by the tool

Section 5 – summary of nonpoint oil and gas emission estimates in the 2017 NEI

Section 6 – recommended future activities for improving nonpoint oil and gas emission inventories

### **Note on greenhouse gas (GHG) emissions**

EPA GHG emissions estimates for oil and gas are available at the national level (GHG Inventory, <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>) and facility-level (Greenhouse Gas Reporting Program, <http://www.epa.gov/ghgreporting/>).

While GHG emissions are not the focus of this tool, they are used in the tool in some places as necessary intermediary steps in the calculation of other pollutants.

## **2.0 BACKGROUND ON DEVELOPMENT OF THE TOOL**

The tool was developed based on work that has been done in this sector over the last several years by various states, inter-governmental agencies, and EPA. These efforts include work done by the Texas Commission on Environmental Quality (TCEQ), the Western Regional Air Partnership (WRAP), and the Central States Air Resource Agencies (CenSARA) to develop improved nonpoint oil and gas emissions inventories.

In 2010, the seven CenSARA states (Texas, Louisiana, Oklahoma, Arkansas, Kansas, Missouri and Nebraska) had a combined oil production of approximately 611 million barrels and a combined gas production of 12.8 trillion cubic feet, representing 48 % of total gas production and 31% of total oil production in the country, including both conventional and unconventional resource plays.<sup>1</sup> As such, the CenSARA inventory effort covered a wide variety of processes and well types and was used as the starting point for the tool. In particular, the Excel-based emission estimation tool that was developed for the CenSARA study was used as the basis for initial development of the tool described in this report. Subsequent updates to the tool incorporated data from numerous additional sources, including the TCEQ and WRAP data mentioned above, related EPA inventory efforts, and data provided to EPA directly from state air agencies.

The basic methodology used to develop the CenSARA inventory was also used to develop the tool and consisted of the following steps:

- Compile activity data - Oil and gas activity data was obtained to include, but is not limited to, the number of active wells by well type, gas production and oil production, spud counts, feet drilled, and water production. The activity data for the tool was primarily obtained from DrillingInfo's HPDI database, a commercial database that processes state-level oil and gas commission data into a comprehensive database of production statistics.<sup>2</sup> Data used in this version of the tool is for the calendar year 2017 and is based on HPDI data as of June 2018. As described further in section 2.1, EPA uses other activity data that is not available in HPDI for certain states.
- Compile process characterization and emission factor data - To initially populate the tool, process characterization data and emissions factors from the CenSARA study were used for the counties in the CenSARA states, and an average of the data for the CenSARA basins were used for the remainder of the counties in the country. Under the CenSARA study, these data were developed or collected from a variety of sources including: 1) oil and gas operator surveys, 2) state minor source permit applications, and 3) literature review. Emission factors for combustion equipment has primarily been taken from AP-42. Much of the initial CenSARA process characterization data used to populate the tool database has since been replaced, as described below in more detail. For example, EPA GHG Reporting Program data (Subpart W) were used

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<sup>1</sup> Internet address: <http://www.eia.gov/>

<sup>2</sup> "DI Desktop Database powered by HPDI." Accessed July 2018. Internet address: <http://www.didesktop.com/>

## **Nonpoint Oil and Gas Emissions Estimation Tool**

to develop default values for several categories, including condensate tanks, crude oil tanks, pneumatic devices, and heaters.<sup>3</sup>

- Incorporate updated process characterization data - Several state and local air quality agencies and Regional Planning Organizations (RPOs) provided updates to replace the default CenSARA and EPA process characterization data. The tool database contains reference information identifying the source of all inputs into the estimates.
- Develop Access-based tool to house the inventory - A Microsoft Access-based tool that estimates 2017 nonpoint oil and gas emissions at the county level was then developed using the compiled activity and process characterization data. The tool has been programmed to be flexible and allow for user-specified inputs such that users may update activity and emissions data at the basin and/or county level for future use. Additional details on the tool and user's instructions are included in Appendices A (Exploration Module) and B (Production Module).

Finally, the tool has been programmed to facilitate NEI submissions by generating EPA Emission Inventory System (EIS) staging tables. These tables can be converted into valid XML files that are in compliance with the EPA-supplied Consolidated Emissions Reporting Schema (CERS) using an EPA-supplied XML File Generator tool. Therefore, the tool allows users to both generate the oil and gas emissions and format them for NEI submission.

### **2.1 Activity Data**

Activity data were obtained at the county level for the entire country to include the key activity parameters that affect emissions. These key activity factors include, but are not limited to, the number of active wells by well type, gas production and oil production by well type, spud count, estimated feet (depth) drilled by wellbore type, and water production by well type. Activity data for the 2017 base year were obtained from the HPDI database, RIGDATA,<sup>4</sup> state oil and gas commission websites, and directly from state and local agencies involved in development and review of the tool.

Table 2-1 presents the activity data parameters used in the tool to calculate emissions.

**Table 2-1. Activity Parameters Needed to Estimate Emissions**

<b>Data Parameter</b>
Oil Production (barrels or BBL)
Natural Gas Production (thousand standard cubic feet or MCF)
CBM Production (thousand standard cubic feet or MCF)

<sup>3</sup> "Summary of Analysis of 2017 GHGRP Subpart W Data for Use in the 2017 NEI Nonpoint Oil and Gas Emission Estimation Tool", Memorandum from Mike Pring and Stephen Treimel to Jennifer Snyder. March 14, 2019.

<sup>4</sup> U.S. Well Starts By Depth Range, January 2017 through December 2017. Used by Permission and Approved for Publication by Jacqueline Hassan at RIGDATA ([www.rigdata.com](http://www.rigdata.com)) in e-mail communication to Regi Oommen, Eastern Research Group, Inc. December 28, 2018.

**Table 2-1. Activity Parameters Needed to Estimate Emissions**

<b>Data Parameter</b>
Condensate Production (BBL)
Associated Gas Production (MCF)
Oil Well Counts
Natural Gas Well Counts
CBM Well Counts
Oil Well Completions (Conventional and Unconventional)
Natural Gas Well Completions (Conventional and Unconventional)
CBM Well Completions (Conventional and Unconventional)
Produced Water Production at Oil Wells (BBL)
Produced Water Production at Gas/CBM Wells (BBL)
Spud Counts (Vertical, Horizontal, Directional)
Feet Drilled (Vertical, Horizontal, Directional)

Table 2-2 presents the activity parameter data sources for each state for the data types identified in Table 2-1.

**Table 2-2. Activity Parameter Data Sources by State**

<b>State</b>	<b>Oil/ Associated Gas Production</b>	<b>Natural Gas/ Condensate Production</b>	<b>CBM Gas/ Condensate Production</b>	<b>Produced Water</b>	<b>Well Completions</b>	<b>Spud Counts/ Feet Drilled</b>
Alabama	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Alaska	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission
Arizona	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission
Arkansas	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
California	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Colorado	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Florida	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI
Idaho	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission

**Table 2-2. Activity Parameter Data Sources by State**

<b>State</b>	<b>Oil/ Associated Gas Production</b>	<b>Natural Gas/ Condensate Production</b>	<b>CBM Gas/ Condensate Production</b>	<b>Produced Water</b>	<b>Well Completions</b>	<b>Spud Counts/ Feet Drilled</b>
Illinois	EIA/ Oil and Gas Commission	EIA/ Oil and Gas Commission	EIA/ Oil and Gas Commission	EIA/ Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission/ RIGDATA
Indiana	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission/ RIGDATA
Kansas	KSDEP	KSDEP	KSDEP	KSDEP	2018 HPDI	KSDEP/ RIGDATA
Kentucky	Oil and Gas Commission	Oil and Gas Commission	Oil and Gas Commission	2018 HPDI	Oil and Gas Commission	Oil and Gas Commission/ RIGDATA
Louisiana	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission/ RIGDATA
Maryland	EIA/ 2018 HPDI	EIA/ 2018 HPDI	EIA/ 2018 HPDI	EIA/ 2018 HPDI	2018 HPDI	2018 HPDI
Michigan	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission/ RIGDATA
Mississippi	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission/ RIGDATA
Missouri	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission
Montana	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Nebraska	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Nevada	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI and Oil and Gas Commission/ RIGDATA
New Mexico	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
New York	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ Oil and Gas Commission

**Table 2-2. Activity Parameter Data Sources by State**

State	Oil/ Associated Gas Production	Natural Gas/ Condensate Production	CBM Gas/ Condensate Production	Produced Water	Well Completions	Spud Counts/ Feet Drilled
North Dakota	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Ohio	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Oklahoma	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Oregon	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission
Pennsylvania	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission	2018 HPDI	2018 HPDI/ RIGDATA
South Dakota	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI
Tennessee	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	Oil and Gas Commission
Texas	TCEQ	TCEQ	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Utah	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA
Virginia	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI
West Virginia	WVDEP	WVDEP	WVDEP	WVDEP/ 2018 HPDI	WVDEP	WVDEP
Wyoming	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI	2018 HPDI/ RIGDATA

### 2.1.1 HPDI and RIGDATA

The primary data source for obtaining activity data was DrillingInfo’s HPDI database. This subscription-based information service extracts well-level data from state oil and gas commission websites and prepares it in a standardized format. As part of EPA’s Enforcement Activities, EPA has an annual subscription to DrillingInfo, allowing data downloads, or “refreshes,” to be obtained throughout the year. In accordance with the EPA’s licensing agreement, well-level data is proprietary, but derived products, such as aggregation at the county-level, are acceptable for public dissemination and use in the tool.

ERG extracted well identification (HPDIHeader) and production (HPDIProduction) information for onshore wells and leases. Table 2-3 provides details on the available data by state, as of the June 2018 refresh. Table 2-3 also includes the update frequency of the data by state and provides the date of the latest production data included in the June 2018 refresh.

**Table 2-3. HPDI Data Coverage by State**

<b>State Abbreviation</b>	<b>Production Group</b>	<b>Update Frequency</b>	<b>Latest Production Data</b>
Alabama	Well	Monthly	March 2018
Alaska	Well	Monthly	April 2018
Arizona	Well	Monthly	January 2017
Arkansas	Well	Monthly	March 2018
California	Well	Monthly	February 2018
Colorado	Well	Monthly	April 2018
Florida	Well	Monthly	April 2018
Kansas	Lease	Monthly	March 2018
Kentucky	Well	Yearly	December 2015
Louisiana	Well/Unit <sup>a</sup>	Monthly	April 2018
Maryland	Well	Semi-annually	December 2015
Michigan	Lease	Monthly	February 2018
Mississippi	Well	Monthly	March 2018
Missouri	Well	Bi-Monthly	December 2017
Montana	Well	Monthly	March 2018
Nebraska	Well	Monthly	April 2018
Nevada	Well	Bi-Monthly	March 2018
New Mexico	Well	Monthly	March 2018
New York	Well	Yearly	December 2016
North Dakota	Well	Monthly	April 2018
Ohio	Well	Monthly <sup>b</sup> /Yearly <sup>b</sup>	December 2017 <sup>c</sup> /June 2018 <sup>c</sup>
Oklahoma	Well	Monthly	March 2018
Oregon	Well	Yearly	December 2017
Pennsylvania	Well	Monthly <sup>b</sup> /Yearly <sup>b</sup>	December 2017 <sup>d</sup> /April 2018 <sup>d</sup>
South Dakota	Well	Yearly	April 2018
Tennessee	Lease	Quarterly	December 2016
Texas	Oil Lease/Gas Well	Twice monthly	April 2018
Utah	Well	Monthly	April 2018
Virginia	Well	Yearly	December 2017
West Virginia	Well	Yearly	December 2016
Wyoming	Well	Monthly	March 2018

<sup>a</sup> Louisiana Department of Natural Resources defines a unit as the “surface area that encompasses part of or the entirety of a reservoir.”

<sup>b</sup> For Ohio and Pennsylvania, production data for conventional wells are updated annually, while production data for unconventional wells are updated monthly.

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- <sup>c</sup> For Ohio, production data for conventional wells are reported through December 2017 while production data for unconventional wells are reported through June 2018.
- <sup>d</sup> For Pennsylvania, production data for conventional wells are reported through December 2017 while production data for unconventional wells are reported through April 2018.

ERG imported all of the data from HPDI into an Oracle database for pre-processing. The Oracle database combines and processes all of the download files into one table of all production wells for the EPA Enforcement Universe Database. The processing steps are discussed below.

- 1) *Combine Monthly Production and Descriptive Information*: For each entity,<sup>5</sup> ERG combined the monthly production with the descriptive information (e.g., API number, lease name, location, operator, completion date, spud date, latest production date) from the HPDIHeader table to create the Wells table for the EPA Enforcement Universe Database.
- 2) *Remove Duplicate Wells*: HPDI includes duplicate information for wells in some states because the data are stored by completion zone rather than at the well or lease level. Because all of the other descriptive data in HPDI are at the well or lease level, ERG combined duplicate API numbers (i.e., well bore identifiers<sup>6</sup>) into a single record to avoid overcounting wells. ERG excluded the records with missing API numbers (i.e., API\_NO is null) from this “remove duplicate well” step. This could result in some over counting of wells, but this should be minimal because a limited number of wells/leases did not have API numbers and there were a small percentage of duplicate wells identified.<sup>7</sup>
- 3) *Create Updated Active Status Flag (ACTIVE\_FLAG)*: ERG created an updated active status flag (ACTIVE\_FLAG) per month using the latest production date (LAST\_PROD\_DATE) after determining that HPDI’s status flag (STATUS) was not always accurate as part of the 2011 version of the Universe Database.<sup>8</sup>
- 4) *Create Monthly Production Flags*: ERG created production flags to identify miscellaneous well types (e.g., injection, observation, abandoned, pressure maintenance, N/A) that have monthly oil and gas production in 2017 (PROD\_01\_17\_FLAG through PROD\_12\_17). The production flag is “Yes” if the monthly oil or gas production is greater than zero.
- 5) *Assign Each Well as Oil, Gas, or CBM*: Each well was reviewed to determine whether it should be labeled as an oil, gas, or CBM well. As such, the following hierarchy was used:
  - a. HPDI designations of CBM;

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<sup>5</sup> HPDI assigns a unique number to each property (i.e., lease, well, unit) in the ENTITY\_ID field.

<sup>6</sup> API numbers are up to 14 digits long and are broken into four segments. The first two digits correspond to the state; the next three digits correspond to the county in the state. The next five digits are the unique well identifier for the county. The next two digits are for the directional side tracks (i.e., horizontal or directional drills that each have different bottom hole locations), with 00 representing the original well bore. The last two digits are the event sequence code that distinguish between original completion, reentries, recompletion, and hole deepenings. Some states do not assign directional side tracks or event sequence codes.

<sup>7</sup> Duplicate wells in states with missing API numbers could be identified using the permit number, which should be unique for each well.

<sup>8</sup> ERG found some wells with an “Active” STATUS had not produced in a number of years, while some wells with an “Inactive” STATUS had production data for 2010.

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- b. Wells that had 2017 oil production, but no 2017 natural gas production were assigned as “oil” wells;
  - c. Wells that had 2017 gas production, but no 2017 oil production were assigned as “gas” wells; and
  - d. Wells that had both 2017 oil and gas production were assigned “gas” if the ratio of gas to oil was greater than 100 MCF per barrel, and were assigned “oil” if the ratio of gas to oil was less than 100 MCF per barrel.
- 6) *Calculate Well Counts*: Counting wells which produced oil, gas, or CBM and summing to the county-level will likely overestimate the number of wells which actually operated for an entire year because wells that operated for only one month would be essentially used as inputs for emission profiles assuming a year of operations for certain source categories. To account for this, monthly well counts were averaged to develop an annual average, and these averages were populated in the tool as:
- a. NONPOINT\_OIL\_WELL\_COUNT
  - b. NONPOINT\_GAS\_WELL\_COUNT, and
  - c. NONPOINT\_CBM\_WELL\_COUNT

With the exception of “Oil (and Condensate) Production” and “Feet Drilled,” all of the data parameters shown in Table 2-1 are reported fields in HPDI. HPDI reports total hydrocarbon liquids production for each well, but does not distinguish between oil and condensate. As described above, each well was designated as either a gas well or an oil well. Liquid hydrocarbons produced at gas wells were then considered to be condensate, and liquid hydrocarbons produced at oil wells were considered to be oil.

Feet drilled and spud counts are needed for the Drilling and Mud Degassing source categories. While HPDI reports spud date and well depth for each well, that information is often lagging or may be incomplete at the time of the data retrieval. Thus, EPA developed an approach for utilizing the well-specific data from HPDI and state websites and from state-level “Well Starts” and “Feet Drilled” published by RIGDATA.<sup>4</sup> The approach is as follows:

- 1) RIGDATA published total “well starts” and “feet drilled” for 28 states:

Alabama*	Florida	Kentucky*	Nebraska*	Ohio*	Utah*
Alaska*	Idaho	Louisiana*	Nevada*	Oklahoma*	West Virginia*
Arkansas*	Illinois	Michigan*	New Mexico*	Oregon*	Wyoming*
California*	Indiana	Mississippi*	New York*	Pennsylvania*	
Colorado*	Kansas*	Montana*	North Dakota*	Texas*	

- 2) Using the well-level spuds data from HPDI, 2017 total well depth were summed to the county-level for 24 of the 28 states (denoted by “\*”). EPA then proportioned the county-level feet drilled totals to match the state totals using county-state proportions of spud counts.
- 3) For the remaining 4 states that did not have 2017 spud counts or well depths in HPDI (Florida, Idaho, Illinois, and Indiana), EPA downloaded well information from the respective state websites and used the counts and well depths to sum to the county-level.

- 4) HPDI identified four additional states that reported drilling information that were not on the RIGDATA list (Arizona, South Dakota, Tennessee, and Virginia). EPA searched these state websites to confirm that drilling occurred in 2017 and did not adjust the spud counts or estimated feet drilled.
- 5) No drilling occurred in Maryland and Missouri in 2017.

### **2.1.2 State Oil and Gas Commission Websites**

As mentioned above, HPDI was the primary source for most oil, casinghead gas (associated gas), natural gas, and condensate activity data for 2017, with the exceptions of Arizona, Idaho, Illinois, Indiana, Kansas, Kentucky, Ohio, Tennessee, and Texas. The 2017 production data for Arizona, Idaho, Kansas, Ohio, and Texas were obtained directly from the respective state agency official. Statewide production data for Indiana was obtained directly from the Indiana Oil and Gas Commission website and allocated to the county-level by the county proportion of active wells (also obtained from its Oil and Gas Commission website) to the total number of statewide wells. Statewide production data for Illinois was obtained directly from the Energy Information Administration (EIA), and allocated to the county-level by the county proportion of wells (from the state oil and gas commission) to the total number of statewide wells. Finally, 2017 state-level production data for Kentucky and Tennessee were obtained from EIA, but were located proportionately to the county-level based on 2016 well-level data from HPDI (2017 well-level data for these two states were not available).

Produced water data were primarily available in HPDI for most of the states. When not reported in HPDI, information was obtained from the state's oil and gas commission website (e.g., Pennsylvania) or directly from the state (e.g., Kansas and Ohio). If produced water data were not available in either HPDI or the state's oil and gas commission websites, then no emission estimates were generated for this source category (e.g., Oklahoma).

Well completions were primarily available in HPDI for most of the states. When not reported in HPDI, information was obtained from the state's oil and gas commission website (e.g., Indiana). If well completions data were not available in either HPDI or the state's oil and gas commission websites, then no emission estimates were generated for this source category (e.g., Idaho).

As a result of this analysis, data from the following state oil and gas commission websites were used to compile the activity data in the tool:

- Arizona Oil and Gas Conservation Commission: <http://www.azogcc.az.gov/>
- Florida Department of Environmental Protection: <https://floridadep.gov/water/oil-gas/documents/oil-and-gas-permit-database>
- Idaho Oil and Gas Conservation Commission: <https://ogcc.idaho.gov/monthly-annual-reports/> and <https://ogcc.idaho.gov/well-files/>

- Illinois: <https://clearinghouse.isgs.illinois.edu/data/geology/location-points-isgs-wells-and-borings-database> and [https://isgs-oas.isgs.illinois.edu/reports/rwservlet?oil\\_permit\\_activity](https://isgs-oas.isgs.illinois.edu/reports/rwservlet?oil_permit_activity)
- Indiana: <http://igs.indiana.edu/pdms/> and <https://www.in.gov/dnr/dnroil/5447.htm>
- Nevada Division of Minerals: [http://data.nbmgs.unr.edu/Public/OilGas/Logs/OilGas\\_Logs\\_API.xlsx](http://data.nbmgs.unr.edu/Public/OilGas/Logs/OilGas_Logs_API.xlsx)
- Oregon Department of Geology and Mineral Industries: <https://www.oregongeology.org/mlrr/oilgas-logs.htm>
- Pennsylvania Office of Oil and Gas Management: <https://www.paoilandgasreporting.state.pa.us/publicreports/Modules/Welcome/Welcome.aspx>
- Tennessee Department of Environment and Conservation: <http://www.tennoil.com/drilling-permits> and <http://www.tennoil.com/drilling-permits>
- Virginia Department of Environmental Quality: <https://www.dmme.virginia.gov/dgo inquiry/frmMain.aspx?ctl=1>

### **2.1.3 National Production Summary**

A summary of the resulting oil and gas 2017 production statistics by state is presented in Table 2-4. This includes key activity indicators such as natural gas production (associated gas, gas well, and coalbed methane gas), crude oil production, and condensate production. States not listed in Table 2-4 (e.g. Connecticut and North Carolina) did not have any oil or gas production in 2017.

**Table 2-4. Oil and Gas Production by State**

State	Oil Wells	Gas Wells	CBM Wells	Oil (BBL)	Associated Gas (MMCF)	Gas Well Gas (MMCF)	Condensate (BBL)	CBM Gas (MMCF)	CBM Condensate (BBL)
Alabama	451	216	5,424	6,588,790	24,670	62,261	19,252	64,000	218,799
Alaska	1,739	194	0	179,322,164	3,020,229	248,292	1,230,799	0	0
Arizona	8	4	0	12,829	0	56	0	0	0
Arkansas	1,538	9,154	50	5,255,912	6,117	691,642	432	1,141	0
California	44,252	1,781	0	172,921,359	136,676	202,999	142,818	0	0
Colorado	14,840	17,841	5,118	127,954,887	713,675	1,092,034	1,441,711	352,116	226,256
Florida	62	1	0	1,925,244	22,972	161	48	0	0
Idaho	0	7	0	0	0	3,775	91,041	0	0
Illinois	46,793	1,176	198	8,314,000	0	1,824	0	307	0
Indiana	5,152	1,914	0	1,779,360	0	5,914	0	0	0
Kansas	52,694	17,665	4,998	35,822,032	34,886	194,860	59,087	20,834	482,392
Kentucky	10,421	18,751	14	2,474,840	0	157,838	0	121	0
Louisiana	17,671	14,181	4	49,650,691	267,937	1,870,610	1,445,354	49	4,983
Maryland	0	1	0	0	0	33	0	0	0
Michigan	4,431	9,825	0	5,931,931	12,162	84,213	6,053	0	0
Mississippi	1,662	1,309	0	17,824,895	14,490	208,029	54,580	0	0
Missouri	1,222	2	1	117,041	0	1	0	0	55
Montana	4,088	4,876	38	20,690,737	52,190	29,084	18,553	224	0
Nebraska	1,741	116	0	1,831,446	55	363	0	0	0
Nevada	48	1	0	283,113	3	0.03	0	0	0
New Mexico	21,783	18,797	5,564	170,920,542	643,822	499,995	909,238	233,529	15,441
New York	2,622	5,923	0	183,902	485	10,916	35	0	0
North Dakota	13,561	180	0	390,646,371	685,250	3,412	11,321	0	0
Ohio	20,749	21,104	5	19,222,046	242,525	1,527,514	810,205	0.4	39
Oklahoma	26,712	26,957	2,545	156,331,043	1,153,240	1,203,340	1,992,285	14,322	202,535
Oregon	0	12	0	0	0	659	0	0	0
Pennsylvania	17,817	57,865	264	5,563,569	169,241	5,300,927	996,836	6,134	3,184
South Dakota	148	45	0	1,303,052	7,055	344	1,269	0	0

**Table 2-4. Oil and Gas Production by State**

<b>State</b>	<b>Oil Wells</b>	<b>Gas Wells</b>	<b>CBM Wells</b>	<b>Oil (BBL)</b>	<b>Associated Gas (MMCF)</b>	<b>Gas Well Gas (MMCF)</b>	<b>Condensate (BBL)</b>	<b>CBM Gas (MMCF)</b>	<b>CBM Condensate (BBL)</b>
Tennessee	1,055	809	0	268,904	241	2,464	1,096	0	0
Texas	186,024	101,067	186	1,110,132,503	2,641,021	5,437,362	152,313,103	8,324	405,887
Utah	5,607	4,946	913	33,944,093	98,544	179,407	525,198	37,232	0
Virginia	24	1,918	5,954	6,378	156	18,409	606	97,063	49
West Virginia	3,053	43,864	136	10,783,768	229,145	1,282,047	2,069,688	3,018	0
Wyoming	12,295	10,469	5,945	70,292,598	444,823	1,214,246	5,238,742	145,974	75,397
<b>Total</b>	<b>520,263</b>	<b>392,971</b>	<b>37,357</b>	<b>2,608,300,040</b>	<b>10,621,608</b>	<b>21,535,031</b>	<b>169,379,350</b>	<b>984,389</b>	<b>1,635,017</b>

## **2.2 Process Characterization Data**

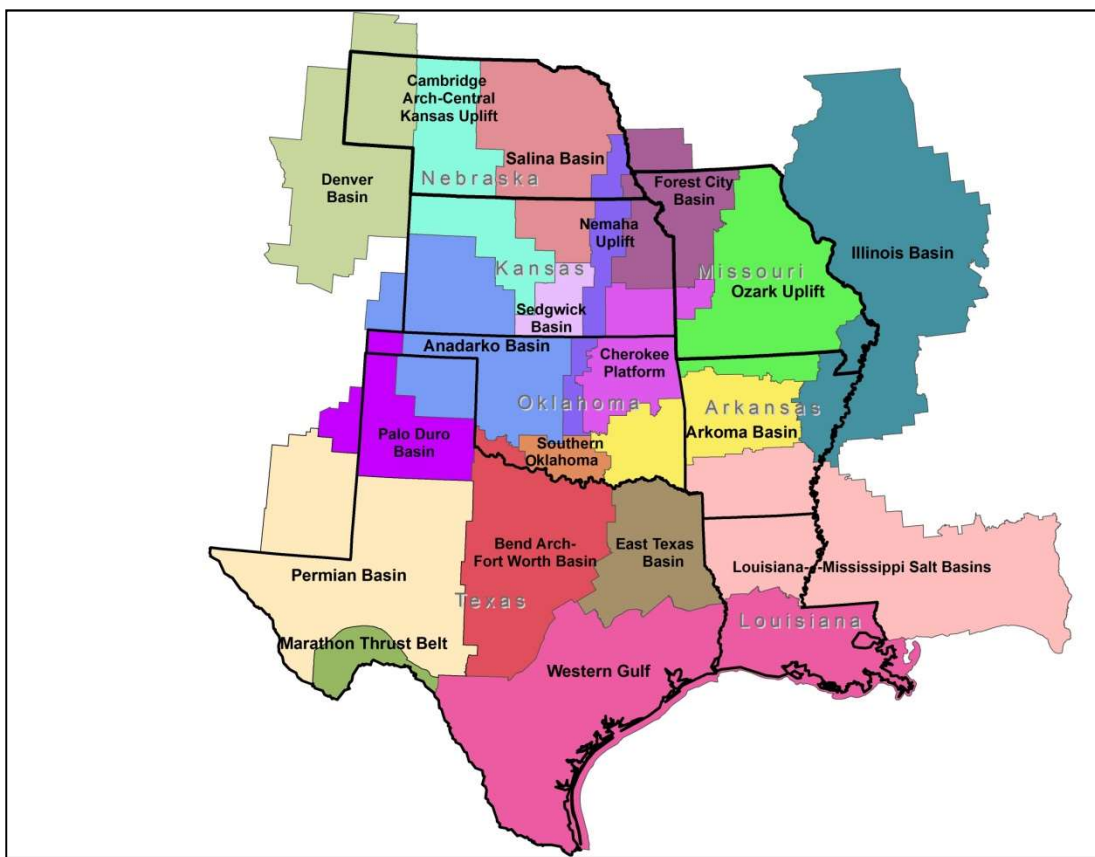
As described in the CenSARA<sup>9</sup> study, while activities can vary within a basin (e.g. both oil and gas operations), the geologically influenced characteristics of a specific basin (e.g. depth, pressure, presence of water, oil quality, gas composition) directly affect activity parameters that describe oil and gas operations within the basin boundaries, and in turn, influence emissions. A basin therefore represents a detailed but tractable geographic unit for development of emissions factors and other process characterization data for oil and gas nonpoint source emissions estimates.

In the CenSARA study, oil and gas nonpoint source emissions were estimated for each county within a discrete basin based on equipment characterization, activity data, and emission factors developed specifically for that basin. This equipment, activity, and emission factor data were obtained through industry surveys, a review of oil and gas datasets compiled by state and local agencies, and from existing studies.

Figure 2-1 below illustrates the 19 oil and gas basins included in the geographic scope of coverage of the CenSARA study.

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<sup>9</sup> ENVIRON International Company. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 2012. Internet address: [www.censara.org/filedepot/folder/10](http://www.censara.org/filedepot/folder/10)

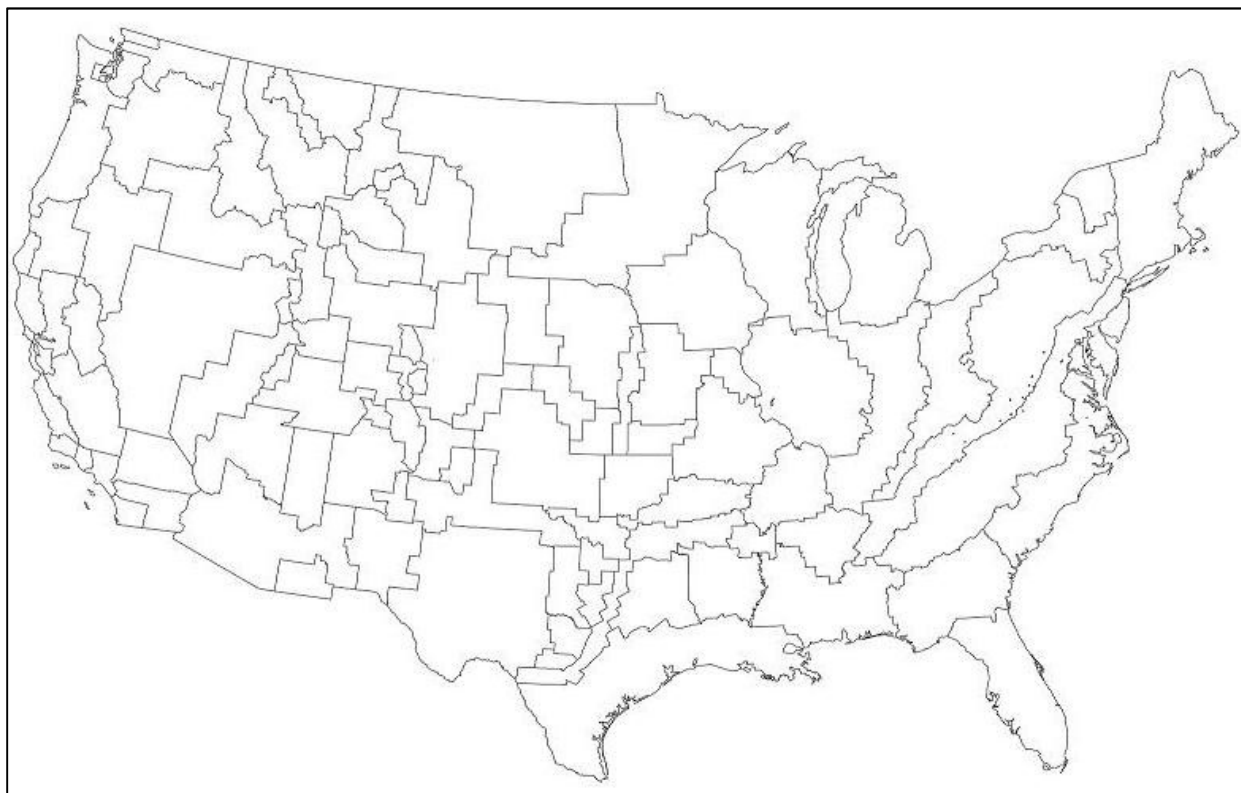


**Figure 2-1. Oil and Gas Basins Covered by the CenSARA Study**

Nationally, the remainder of the country was sub-divided into oil and gas basins (as defined by the geologic provinces published by the American Association of Petroleum Geologists (AAPG)) as used under Subpart W of the Greenhouse Gas Reporting Program (GHGRP).<sup>10</sup>

Using the AAPG definitions, the country is divided into 114 distinct oil and gas basins. Figure 2-2 below illustrates the geographic division of the country into oil and gas basins as defined by the geologic provinces published by the AAPG.

<sup>10</sup> U.S. EPA, 2013. Subpart W Basin and County Combinations. Internet address: <http://www.cedsupport.com/confluence/display/help/Subpart+W+Basin+and+County+Combinations>



**Figure 2-2. Oil and Gas Basins as Defined by the Geologic Provinces Published by the AAPG**

The basic methodology employed in development of the CenSARA inventory was used to develop the national tool described in this report. However, during development and review of the tool by various stakeholders as part of the initial tool development for the 2011 NEI, it was determined that county-level resolution was needed to accommodate differing operational characteristics within a basin. Therefore, the tool currently resolves equipment characterization and activity data down to the county level.

For the CenSARA states, the input data from the CenSARA study have been used in the tool. For several oil and gas basins located in states adjacent to the CenSARA states, the AAPG basin definitions overlap into the CenSARA states. Therefore, CenSARA basin-specific data was used to initially populate the tool database for these basins. Table 2-5 identifies the basins adjacent to the CenSARA states where CenSARA basin-specific data was initially input into the tool.

**Table 2-5. Oil and Gas Basins Adjacent to CenSARA States**

<b>AAPG Basin</b>	<b>Affected States</b>	<b>CenSARA basin</b>
Anadarko Basin	CO	Anadarko Basin
Las Animas Arch	CO	Cambridge Arch-Central Kansas Uplift
Chadron Arch	SD	Cambridge Arch-Central Kansas Uplift

**Table 2-5. Oil and Gas Basins Adjacent to CenSARA States**

<b>AAPG Basin</b>	<b>Affected States</b>	<b>CenSARA basin</b>
Denver Basin	CO, WY	Denver Basin
Forest City Basin	IA	Forest City Basin
Upper Mississippi Embayment	KY, MS, TN	Illinois Basin
Desha Basin	MS	Louisiana-Mississippi Salt Basins
Illinois Basin	IL, IN, KY	Illinois Basin
Palo Duro Basin	NM	Palo Duro Basin
Permian Basin	NM	Permian Basin
Orogrande Basin	NM	Permian Basin
Mid-Gulf Coast Basin	AL, FL, MS	Western Gulf

Finally, for those basins falling entirely outside of the CenSARA states, national averages for equipment profiles and activity levels were developed based on the average of the surveyed basins within the CenSARA states. While this data were used to initially populate the input data for the tool database, many different state agencies, RPOs, and EPA supplied data that have been used in the current version of the tool.

For example, for certain source categories such as well completions and mud degassing, gas composition data developed by EPA for regulatory development purposes was used for the non-CenSARA basins.<sup>11</sup> Gas composition profiles developed under this effort were used as default profiles for:

- Associated Gas Venting (Oil Wells)
- Fugitives (Gas Wells)
- Gas-Actuated Pumps (Gas Wells)
- Liquids Unloading (Gas Wells)
- Mud Degassing (Oil and Gas Wells)
- Pneumatic Devices (Gas Wells)
- Well Completions (Oil and Gas Wells)

Appendix C contains a comprehensive list of each county in the United States and the associated AAPG oil and gas basin name, and under the CenSARA inventory (if applicable). Appendix C also identifies what data was initially used to populate the tool database for each county. This was either data from a specific CenSARA basin for the CenSARA states (CENSARA\_2012), data from a specific CenSARA basin for certain basins/counties adjacent to the CenSARA states as listed in Table 2-5 (CENSARA\_EXTENSION), or nationally-averaged data from all CenSARA basins (CENSARA\_AVG). While Appendix C identifies the initial reference for the data used to populate the tool database, numerous updates have been made to the tool since it was initially developed to incorporate EPA, state, and local data. The tool

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<sup>11</sup> U.S. EPA, 2011. "Composition of Natural Gas for use in the Oil and Natural Gas Sector Rulemaking", Memorandum from Heather P. Brown to Bruce Moore. July 28, 2011.

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database contains specific references at the county level for each data element used in the emission estimation algorithms.

Table 2-6 provides a broad overview of the types of data currently found in the tool. The table indicates “S” for state supplied data, “D” for default CenSARA data, “E” for EPA data, “B” for Bureau of Ocean Energy Management (BOEM) data, or “R” for RPO data (e.g. CenSARA or WRAP). In many instances, a mix of these data types are used to estimate emissions for a single source category. In these cases, each type of data found in the tool is identified.

**Table 2-6. Tool Data Sources by State and Source Type**

State	Artificial Lifts	Associated Gas	Condensate Tanks	Crude Oil Tanks	Dehydrators	Drilling Rigs	Fugitive Leaks	Gas-actuated Pumps	Heaters	Hydraulic Fracturing Pumps	Lateral/Gathering Compressor Engines	Liquids Unloading	Loading	Mud Degassing	Pneumatic Devices	Produced Water Tanks	Well Completions	Wellhead Compressor Engines
AL	D, S	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, S
AK	D	B, D, E	D, E, S	D, E, S	D, E	D	B, D, E	D, E	D	D	D, E	D, E	D, E	B, D, E	D	B, D, E	D, E	D
AZ	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
AR	R	E, R	E, R	E, R	E, R	R	R	E, R	R	R	R	E, R	R	E, R	R	E, R	R	R
CA	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
CO	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R
FL	D, S	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, S
ID	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
IL	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R
IN	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R
KS	R	E, R	E, R	E, R	E, R	R	R, S	E, R	R	R	R, S	E, R	R	E, R, S	R	E, R, S	R	R
KY	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R
LA	R, S	E, R	E, R, S	E, R	E, R	R	R	E, R	R	R	R	E, R	R	E, R	R	E, R	R	R, S
MD	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D

**Table 2-6. Tool Data Sources by State and Source Type**

State	Artificial Lifts	Associated Gas	Condensate Tanks	Crude Oil Tanks	Dehydrators	Drilling Rigs	Fugitive Leaks	Gas-actuated Pumps	Heaters	Hydraulic Fracturing Pumps	Lateral/Gathering Compressor Engines	Liquids Unloading	Loading	Mud Degassing	Pneumatic Devices	Produced Water Tanks	Well Completions	Wellhead Compressor Engines
MI	D	D, E	D, E	D, E	D, E, S	D	D, E	D, E, S	D	D, S	D, E	D, E	D, E	D, E	D	D, E	D, E, S	D
MS	D, R, S	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R, S
MO	R	E, R	E, R	E, R	E, R	R	R	E, R	R	R	R	E, R	R	E, R	R	E, R	R	R
MT	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E	D, E, R	D, R	D, E, R	D, E, R	D, R
NE	R	E, R	E, R	E, R	E, R	R	E, R	E, R	R	R	E, R	E, R	R	E, R	R	E, R	R	R
NV	D, S	D, E	D, E	D, E	D, E, S	D	D, E, S	D, E, S	D	D, S	D, E, S	D, E	D, E	D, E, S	D	D, E	D, E, S	D, S
NM	D, R, S	D, E, R	D, E, R	D, E, R	D, E, R	D, R, S	D, E, R	D, E, R	D, R, S	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R, S
NY	D, S	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D, S	D, E, S	D, E	D, E	D, E, S	D	D, E	D, E, S	D, S
ND	R	E, R	E, R	E, R	E, R	R	R	E, R	R	R	R	E, R	D, E	E, R	R	R	R	R
OH	D, S	D, E	D, E	D, E	D, E, S	D	D, E, S	D, E	D	D, S	D, E, S	D, E	D, E	D, E, S	D	D, E	D, E, S	D, S
OK	R, S	E, R	E, R, S	E, R	E, R	R	R	E, R	R	R	R	E, R	R	E, R	R	E, R	R	R, S
OR	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
PA	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
SD	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R

**Table 2-6. Tool Data Sources by State and Source Type**

State	Artificial Lifts	Associated Gas	Condensate Tanks	Crude Oil Tanks	Dehydrators	Drilling Rigs	Fugitive Leaks	Gas-actuated Pumps	Heaters	Hydraulic Fracturing Pumps	Lateral/Gathering Compressor Engines	Liquids Unloading	Loading	Mud Degassing	Pneumatic Devices	Produced Water Tanks	Well Completions	Wellhead Compressor Engines
TN	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R
TX	S	E, R	E, R, S	E, R	E, R, S	R	E, R	E, R	R, S	R, S	E, R	E, R	R, S	E, R, S	R	E, R, S	R, S	S
UT	D, R	D, E	D, E, R	D, E, R	D, E, R	D, R, S	D, E, R	D, E, R	D	D, R	D, E, R	D, E, R	D, E	D, E, R	D	D, E, R	D, E, R	D, R
VA	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D	D	D, E	D, E	D, E	D, E	D	D, E	D, E	D
WV	D	D, E, S	D, E, S	D, E	D, E	D	D, E, S	D, E	D	D	D, E, S	D, E, S	D, E	D, E	D	D, E, S	D	D
WY	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R	D, R	D, E, R	D, E, R	D, E, R	D, E, R	D, R	D, E, R	D, E, R	D, R

<sup>a</sup> D = Default data from CenSARA Study, E = EPA, R = RPO (CenSARA or WRAP), S = state, B = BOEM

## 2.3 Updates Since 2014

The final version of the 2014 Nonpoint Oil and Gas Emission Estimation Tool was completed in June of 2017. Version 1 of the 2017 Nonpoint Oil and Gas Emission Estimation Tool was completed in April of 2019. The primary updates made since finalization of the 2014 version of the tool include:

- **Updated Activity Data.** Oil and gas exploration and production activity data was updated to reflect 2017 as described in Section 2.1 using data from the HPDI database, RIGDATA, and various state oil and gas commission websites.
- **Basin Factor Updates.** GHGRP data was analyzed to develop updated basin factors for several source categories including storage tanks, dehydrators, fugitive equipment leaks, heaters, pneumatic devices, and wellhead compressor engines.
- **Emission Factor Updates.** Drilling and hydraulic fracturing engine emission factors were updated using the MOVES model for 2017; speciated PM factors (PM10-FIL, PM25-FIL, and PM-CON) were added for artificial lifts, CBM dewatering pumps engines, dehydrators, heaters, lateral compressor engines, and wellhead compressor engines; and updated conventional and unconventional oil well completion factors were added.
- **Emission Estimation Methodology Updates.** Vapor recovery units (VRUs) were added as a control device for condensate and crude oil tanks.
- **Temperature Updates.** Updated annual average temperature data by county using EPA's 2017 Weather Research Factorization (WRF) model data.
- **Additional Source Category.** Coalbed methane well dewatering pump engines were added to the tool as a new source category.
- **Additional Pollutants.** Additional HAPs were added to the tool in preparation for the 2017 NEI oil and gas tool.
- **Updated SCCs.** SCCs were added or revised as shown in Table 2-7.

**Table 2-7. Updated SCC Codes**

Source Category	SCC	SCC Description
Artificial Lift Engines	2310011600	Oil and Gas: Onshore Oil Production/Artificial Lift Engines
Associated Gas Venting	2310011001	Oil and Gas: Onshore Oil Production/Associated Gas Venting
CBM Dewatering Pump Engines	2310023000	Coal Bed Methane NG/Dewatering Pump Engines

**Table 2-7. Updated SCC Codes**

<b>Source Category</b>	<b>SCC</b>	<b>SCC Description</b>
Produced Water Tanks	2310000551	Produced Water from CBM Wells
Produced Water Tanks	2310000552	Produced Water from Gas Wells
Produced Water Tanks	2310000553	Produced Water from Oil Wells

### 3.0 SOURCE CATEGORY EMISSION ESTIMATION METHODOLOGIES

Emissions for individual oil and gas nonpoint source categories were developed using a bottom-up approach that begins with developing mass emission rates for each pollutant based on an activity surrogate (e.g. tons per well, tons per barrel of oil, tons per feet drilled). These by-surrogate emission rates were then scaled to county-level emissions by multiplying the emission rates by the scaling surrogate or activity from a particular county (e.g. gas well counts, horizontal feet drilled, crude oil production, etc.).

Emissions calculations are performed within the Microsoft Access database. Data field names and definitions for calculation inputs are shown in Appendix D (Data Element Dictionary) in the same format and nomenclature as they appear in the database tool. Appendix D also provides the national “default” value for each variable (and reference) used in the calculations when state-supplied data is unavailable. Refer to the instructions included in Appendices A and B for details on how the database is organized.

The following sections describe emissions calculations for each source category; it is noted that some of these methodologies may apply to multiple SCCs and thus, are calculated separately in the tool. Example calculations are provided for each source category. The examples are provided for illustrative purposes only and may not match the totals calculated by the tool due to rounding or updates to any of the activity or emission factor inputs.

Table 3.1 below identifies the source categories associated with each type of well (oil or gas), and the primary activity parameter used as the basis to scale emissions up to the county level.

**Table 3-1. Emission Sources by Well Type**

Category	Activity Basis	Oil	CBM	Gas
Artificial Lifts	Oil Well Count	Yes	No	No
Associated Gas	Oil Production	Yes	No	No
Coalbed Methane Dewatering Pump Engines	CBM Well Counts	No	Yes	No
Condensate Tanks	Condensate Production	No	Yes	Yes
Crude Oil Tanks	Oil Production	Yes	No	No
Dehydrators	Gas, Associated Gas, and CBM Production; Gas and CBM Well Counts	No	Yes	Yes
Drill Rigs	Estimated Feet Drilled	Yes	Yes	Yes
Fugitive Leaks	Oil, Gas, and CBM Well Count	Yes	Yes	Yes
Gas-Actuated Pumps	Oil, Gas, and CBM Well Count	Yes	Yes	Yes
Heaters	Oil, Gas, and CBM Well Count	Yes	Yes	Yes
Hydraulic Fracturing Pumps	Horizontal Spud Count	Yes	Yes	Yes
Lateral/Gathering Compressor Engines	Gas and CBM Well Count	No	Yes	Yes
Liquids Unloading	Gas and CBM Well Count	No	Yes	Yes
Loading	Oil and Condensate Production	Yes	Yes	Yes

**Table 3-1. Emission Sources by Well Type**

Category	Activity Basis	Oil	CBM	Gas
Mud Degassing	Spud Counts	Yes	Yes	Yes
Pneumatic Devices	Oil, Gas, and CBM Well Count	Yes	Yes	Yes
Produced Water Tanks	Produced Water Production	Yes	Yes	Yes
Well Completions	Completion Count	Yes	Yes	Yes
Wellhead Compressors	Gas and CBM Well Count	No	Yes	Yes

### 3.1 Artificial Lifts

Artificial lifts refer specifically to engines located at oil wells that provide lift to the liquids in a well up to the wellhead. Generally, artificial lift engines are small natural-gas fired engines. In the past decade, there has been an increased use of electrified artificial lift engines powered by the grid; for this kind, emissions are assumed to be zero. Figure 3-1 shows a pump jack with an artificial lift engine (inset).<sup>1</sup>

**Figure 3-1. Artificial Lift Engine**

<sup>1</sup> Personal Communication between Ms. Julie McDill, MARAMA, Ms. Megan Murphy, WVDEP, and Mr. Mike Pring, Eastern Research Group, Inc. January 24, 2014.

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The basic methodology for estimating emissions from a single non-electrified artificial lift engine is shown below:

$$\text{Equation 1)} \quad E_{\text{engine}} = \frac{EF_i \times HP \times LF \times t_{\text{annual}}}{907,185}$$

where:

$E_{\text{engine}}$  are emissions from an artificial lift engine [ton/year/engine]

$EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr]

$HP$  is the horsepower of the engine [hp]

$LF$  is the load factor of the engine

$t_{\text{annual}}$  is the annual number of hours the engine is used [hr/yr]

907,185 is the unit conversion factor g/ton

### Extrapolation to county-level emissions

Artificial lift engine emissions have been scaled up to the county level on the basis of oil well counts. The methodology for scaling up artificial lift engine emissions is shown below:

$$\text{Equation 2)} \quad E_{\text{engine},\text{TOTAL}} = n \times E_{\text{engine}} \times f_{\text{pumpjack}} \times (1 - FE) \times W_{\text{OIL},\text{TOTAL}}$$

where:

$E_{\text{engine},\text{TOTAL}}$  is the total emissions from artificial lift engines in a county [ton/yr]

$n$  is the total number of artificial lift engines per well [engine/well]

$E_{\text{engine}}$  is the total emissions from an artificial lift engine (as shown in Equation 1) [ton/yr/engine]

$f_{\text{pumpjack}}$  is the fraction of oil wells with artificial lift engines

$FE$  is the fraction of artificial lift engines that are electric

$W_{\text{OIL},\text{TOTAL}}$  is the total number of **oil** wells in a county [wells]

### Example Calculation for Artificial Lift:

Using the equations provided above, NO<sub>x</sub> emissions from artificial lift engines in Calhoun County, Arkansas were calculated as follows:

$$E_{\text{engine}} = \frac{EF \times HP \times LF \times t_{\text{annual}}}{907,185}$$

where:

$E_{\text{engine}}$  = emissions from an artificial lift engine [ton/yr/engine]

$EF = 8.24$  [g/hp-hr]

$HP = 77.5$  [hp]

$LF = 0.85$  (load factor for the engine)

$t_{\text{annual}} = 8,000$  [hr/yr]

907,185 [g/ton]

Therefore:

$$E_{engine} = \frac{8.24 \times 77.5 \times 0.85 \times 8,000}{907,185}$$

$$E_{engine} = 4.79 \text{ [ton/yr/engine]}$$

Total NO<sub>x</sub> emissions from all artificial lift engines in Calhoun County can be evaluated as follows:

$$E_{engine,TOTAL} = n \times E_{engine} \times f_{pumpjack} \times (1 - FE) \times W_{OIL,TOTAL}$$

where:

$E_{engine,TOTAL}$  is the total emissions from artificial lift engines in a county [ton/yr]

$n = 1$  [engine/well]

$E_{engine} = 4.79$  [ton/yr/engine]

$f_{pumpjack} = 0.95$  (fraction of oil wells with artificial lift engines)

$FE = 0.965$  (fraction of artificial lift engines that are electrified)

$W_{OIL,TOTAL} = 18$  [wells]

Therefore:

$$E_{engine,TOTAL} = 1 \times 4.79 \times 0.95 \times (1 - 0.965) \times 18$$

$$E_{engine, TOTAL} = 2.86 \text{ [ton/yr]}$$

### 3.2 Associated Gas Venting and Flaring

This section refers to the practice of venting associated gas from oil wells which sometimes takes place when the well is not connected to a gas sales pipeline or when the amount of gas produced by the well is so limited that is not profitable for capture. In some areas of the country, this gas may be flared.

The calculation methodology for estimating county-wide emissions from associated gas venting is shown below in Equation 3:

$$\text{Equation 3) } E_{assoc,gas,i} = \left( \frac{P \times (Q_{assoc,gas,i}) \times P_{oil}}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f_i}{907,185} \times (1 - F_{flare} \times C_{captured} \times C_{efficiency})$$

where:

$E_{assoc, gas,i}$  is the county-wide emissions of pollutant  $i$  from associated gas venting [ton/yr]

$P$  is atmospheric pressure [1 atm]

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$Q_{assoc,gas,i}$  is the venting rate of associated gas per unit of oil production [MCF/bbl]

$P_{oil}$  is the annual county-wide oil production [bbl/yr]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_i$  is the mass fraction of pollutant  $i$  in the associated gas

$F_{flare}$  is the fraction of associated gas controlled with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

#### **Flaring emissions from associated gas controls**

Emissions from flaring controls applied to associated gas are included in this source category. The methodology for estimating emissions from flaring of associated gas is described below:

$$\text{Equation 4)} \quad E_{flare,assoc,gas} = \left( \frac{EF_i \times Q_{assoc,gas} \times F \times (C_{captured}) \times (C_{efficiency}) \times HV}{1,000} \times P_{oil} \right) / 2,000$$

where:

$E_{flare,assoc,gas}$  is the county-wide flaring emissions of pollutant  $i$  from vented associated gas [ton/yr]

$EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]

$Q_{assoc,gas}$  is the volume of associated gas vented per barrel of oil produced [MCF/bbl]

$F$  is the fraction of associated gas vent controlled with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$HV$  is the local heating value of the gas [BTU/SCF]

$P_{oil}$  is the annual county-wide oil production [bbl/yr]

2,000 is the unit conversion factor lbs/ton

The methodology for estimating SO<sub>2</sub> emissions from flaring of associated head gas is shown below:

Equation 5)

$$E_{assocgas,flare,SO_2} = \left( \frac{P \times (Q_{assoc,gas}) \times P_{oil}}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times 2 \times \frac{f_{H_2S}}{907,185} \times F_{flare} \times (C_{captured}) \times (C_{efficiency})$$

where:

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$E_{assoc,gas,flare,SO_2}$  is the county-wide  $SO_2$  emissions from flaring of associated gas [ton/yr]

$P$  is atmospheric pressure [1 atm]

$Q_{assoc,gas}$  is vented volume of associated gas per barrel of oil [MCF/bbl]

$P_{oil}$  is the annual county-wide oil production [bbl/yr]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the associated gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{H_2S}$  is the mass fraction of  $H_2S$  in the associated gas

$F_{flare}$  is the fraction of associated gas vents controlled by flare

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

### Extrapolation to county-level emissions

County-wide emissions from associated gas venting and associated gas flaring are estimated directly from Equations 3-5. The sum of venting and flaring emissions by pollutant yield the total county-wide emissions from associated head gas that is not captured for sale.

### Example Calculation for Associated Gas Venting:

Using the equations provided above, VOC emissions for associated gas venting in Columbia County, Arkansas were calculated as follows:

$$E_{assoc,gas} = \left( \frac{P \times (Q_{assoc,gas}) \times P_{oil}}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f}{907,185} \times (1 - F_{flare} \times C_{captured} \times C_{efficiency})$$

where:

$E_{assoc,gas}$  is the county-wide emissions of VOC from associated gas venting [ton/bbl]

$P = 1$  [atm]

$Q_{assoc,gas} = 0.00365$  [MCF/bbl]

$P_{oil} = 1,231,945$  [bbl/yr]

$R = 0.082$  [L-atm/mol-K]

$MW_{gas} = 24.25$  [g/mol]

$T = 298$  [K]

$f = 0.262$  (the mass fraction of VOC in the associated gas)

$F_{flare} = 0$  (the fraction of associated gas vent controlled with flares)

$C_{captured} = 1.0$  (capture efficiency expressed as fraction)

$C_{efficiency} = 0.98$  (control efficiency expressed as fraction)

$3.5 \times 10^{-5}$  [MCF/L]

907,185 [g/ton]

Therefore:

$$E_{assoc,gas} = \left( \frac{P \times (0.00365) \times 1,231,945}{\left( \frac{0.082}{24.25} \right) \times 298 \times 3.5 \times 10^{-5}} \right) \times \frac{0.262}{907,185} \times (1 - 0 \times 1.0 \times 0.98)$$

$$E_{assoc,gas} = 36.82 \text{ [ton/yr]}$$

Flaring emissions would be calculated similarly to the example given above for condensate tanks. In this case, since it is assumed that the fraction of associated gas controlled by flares is zero, there are no flare emissions.

### **3.3 Coalbed Methane Dewatering Pump Engines**

Coalbed methane (CBM) dewatering pump engines refer specifically to engines located at CBM wells that provide lift to bring the water in the well up to the wellhead. Removing water from CBM wells allows the methane to flow freely through the fissures in the coal seam to the well. Generally, CBM dewatering pump engines are small natural gas or diesel-fired engines. Where electricity is available, CBM dewatering pump engines may be powered by electric motors or electric-powered submersible pumps may be used for removing water. For CBM dewatering pumps powered by electricity, emissions are assumed to be zero.

Figure 3-2 shows a CBM dewatering pump.



**Figure 3-2. Coalbed Methane Dewatering Pump**

The basic methodology for estimating emissions from a single non-electrified CBM dewatering pump engine is shown below:

Equation 1) 
$$E_{engine} = \frac{EF_i \times HP \times LF \times t_{annual}}{907,185}$$

where:

$E_{engine}$  are emissions from a CBM dewatering pump engine [ton/year/engine]

$EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr]

$HP$  is the horsepower of the engine [hp]

$LF$  is the load factor of the engine

$t_{annual}$  is the annual number of hours the engine is used [hr/yr]

907,185 is the unit conversion factor g/ton

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### **Extrapolation to county-level emissions**

CBM dewatering pump engine emissions have been scaled up to the county level on the basis of CBM well counts. The methodology for scaling up CBM dewatering pump engine emissions is shown below:

Equation 2) 
$$E_{engine, TOTAL} = n \times E_{engine} \times f_{pump} \times (1 - FE) \times W_{CBM, TOTAL}$$

where:

$E_{engine, TOTAL}$  is the total emissions from CBM dewatering pump engines in a county [ton/yr]

$n$  is the total number of CBM dewatering pump engines per well, generally equal to 1 ( $n=1$ ) [engine/well]

$E_{engine}$  is the total emissions from a CBM dewatering pump engine (as shown in Equation 1) [ton/yr/engine]

$f_{pump}$  is the fraction of CBM wells with dewatering pump engines

$FE$  is the fraction of CBM dewatering pump engines that are electric

$W_{CBM, TOTAL}$  is the total number of CBM wells in a county [wells]

### **Example Calculation for CBM dewatering pump engines:**

Using the equations provided above, NO<sub>x</sub> emissions from CBM dewatering pump engines in Calhoun County, Arkansas may be calculated as follows:

$$E_{engine} = \frac{EF \times HP \times LF \times t_{annual}}{907,185}$$

where:

$E_{engine}$  = emissions from a CBM dewatering pump engine [ton/yr/engine]

$EF = 8.24$  [g/hp-hr]

$HP = 77.5$  [hp]

$LF = 0.85$  (load factor for the engine)

$t_{annual} = 8,000$  [hr/yr]

907,185 [g/ton]

Therefore:

$$E_{engine} = \frac{8.24 \times 77.5 \times 0.85 \times 8,000}{907,185}$$

$$E_{engine} = 4.79 \text{ [ton/yr/engine]}$$

Total NO<sub>x</sub> emissions from all CBM dewatering pump engines in Calhoun County can be evaluated as follows:

$$E_{engine, TOTAL} = n \times E_{engine} \times f_{pump} \times (1 - FE) \times W_{CBM, TOTAL}$$

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where:

$E_{engine, TOTAL}$  is the total emissions from CBM dewatering pump engines in a county [ton/yr]

$n = 1$  [engine/well]

$E_{engine} = 4.79$  [ton/yr/engine]

$f_{pump} = 0.95$  (fraction of CBM wells with CBM dewatering pump engines)

$FE = 0.965$  (fraction of CBM dewatering pump engines that are electrified)

$W_{CBM, TOTAL} = 18$  [wells]

Therefore:

$$E_{engine, TOTAL} = 1 \times 4.79 \times 0.95 \times (1 - 0.965) \times 18$$

$$E_{engine, TOTAL} = 2.86 \text{ [ton/yr]}$$



[Note – the example above is for illustrative purposes only, there are currently no default factors available to estimate emissions from CBM dewatering pump engines.]

### 3.4 Condensate Tanks

Condensate storage tanks are considered a significant source of VOC emissions. Liquid storage tank losses are generated by flashing and by working and breathing processes, although generally the emissions are dominated by flashing losses. This analysis uses a combined-losses emissions factor and assumes that the gas compositions from both processes are identical. Figure 3-3 shows liquid storage tanks in the Barnett Shale.

**Figure 3-3. Liquid Storage Tanks**

The methodology for estimating condensate tank combined losses is shown below:

Equation 6)

$$E_{condensate, tanks, VOC} = \frac{EF_{condensate, tanks, VOC}}{2,000} \times [1 - F_{VRU} - F_{flare} \times C_{captured} \times C_{efficiency}]$$

## **Nonpoint Oil and Gas Emissions Estimation Tool**

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where:

$E_{condensate,tanks,VOC}$  is the VOC emissions per liquid unit throughput from condensate tanks [tons/bbl]

$EF_{condensate,tanks,VOC}$  is the VOC emissions factor for combined losses from condensate tanks [lb-VOC/bbl]

$F_{VRU}$  is the fraction of condensate tanks controlled by vapor recovery units

$F_{flare}$  is the fraction of condensate tanks with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

2,000 is the unit conversion factor lb/ton

The methodology for estimating condensate tank combined losses from other pollutants  $i$  in the gas is shown below:

Equation 7) 
$$E_{condensate,tanks,i} = E_{condensate,tanks,VOC} \times \frac{weigh\ fraction_i}{weight\ fraction_{VOC}}$$

where:

$E_{condensate,tanks,i}$  is the emissions of pollutant  $i$  per liquid unit throughput from condensate tanks [tons/bbl]

$E_{condensate,tanks,VOC}$  is the VOC emissions per liquid unit throughput from condensate tanks [tons-VOC/bbl]

$(weight\ fraction_i/weight\ fraction_{VOC})$  is the mass-based weight fraction of pollutant  $i$  divided by the weight fraction of VOC in the gas

### **Flaring emissions from condensate tank controls**

This source category includes any flaring emissions associated with controls applied to condensate tanks. The methodology for estimating emissions from flaring of condensate tank flash gas is described below:

Equation 8)

$$E_{flare,tank,i} = P_{condensate} \times \left( Q_{condensate,tanks} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times \frac{EF_i \times HV}{1,000} \right) / 2,000$$

where:

$E_{flare,tank,i}$  is the county-wide flaring emissions of pollutant  $i$  from condensate tank controls [ton/yr]

$P_{condensate}$  is the annual county-wide condensate production [bbl/yr]

$Q_{condensate,tank}$  is the uncontrolled volume of tank losses vented per unit of condensate throughput [MCF/bbl]

$F_{flare}$  is the fraction of condensate tanks with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

### **Nonpoint Oil and Gas Emissions Estimation Tool**

$EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]

$HV$  is the local heating value of the gas [BTU/SCF]

2,000 is the unit conversion factor lb/ton

1,000 is the unit conversion factor MCF/MMCF

The methodology for estimating SO<sub>2</sub> emissions from flaring of oil and condensate flash gas is shown below:

Equation 9)

$$E_{flare,tank,SO_2} = \left( \frac{P \times (Q_{condensate,tank} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times P_{condensate})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times f_{H_2S} \times \frac{2}{907,185}$$

where:

$E_{flare,tank,SO_2}$  is the county-wide SO<sub>2</sub> flaring emissions from condensate tanks controls [ton/yr]

$P$  is atmospheric pressure [1 atm]

$Q_{condensate,tank}$  is the uncontrolled volume of tank losses vented per unit of condensate throughput [MCF/bbl]

$F_{flare}$  is the fraction of condensate tanks with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$P_{condensate}$  is the annual county-wide condensate production [bbl/yr]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the flash gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{H_2S}$  is the mass fraction of H<sub>2</sub>S in the flash gas

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

### **Extrapolation to county-level emissions**

To estimate county-wide total controlled and uncontrolled condensate tank emissions, which includes venting and flaring, for each pollutant  $i$ , Equation 10 below is used:

Equation 10) 
$$E_{condensate,tanks,TOTAL} = E_{condensate,tanks,i} \times P_{condensate} \times F_{tank} + E_{flare,tanks,i}$$

where:

$E_{condensate,tanks,TOTAL}$  is the county-wide total emissions for pollutant  $i$  from condensate tanks [tons/yr]

$E_{condensate,tanks,i}$  is the combined losses of pollutant  $i$  per liquid unit throughput from condensate tanks [tons/bbl]

## **Nonpoint Oil and Gas Emissions Estimation Tool**

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$P_{condensate}$  is the annual county-wide condensate production [bbl/yr]

$F_{tank}$  is the fraction of condensate directed to tanks [%]

$E_{flare,tanks,i}$  is the county-wide flaring emissions of pollutant  $i$  from condensate tank controls [ton/yr]

### **Example Calculation for Condensate Tanks:**

Using the equations provided above, VOC and SO<sub>2</sub> emissions from condensate tank venting and flaring in Columbia County, Arkansas were calculated as follows:

Venting Emissions:

$$E_{condensate,tanks,VOC} = \frac{EF_{condensate,tanks,VOC}}{2,000} \times [1 - F_{VRU} - F_{flare} \times C_{captured} \times C_{efficiency}]$$

where:

$E_{condensate,tanks,VOC}$  is the VOC emissions per liquid unit throughput from condensate tanks [tons/bbl]

$EF_{condensate,tanks,VOC} = 3.60$  [lb-VOC/bbl]

$F_{VRU} = 0$  (fraction of condensate tanks controlled by a VRU)

$F_{flare} = 0.315$  (fraction of condensate tanks with flares)

$C_{captured} = 1.0$  (capture efficiency expressed as fraction)

$C_{efficiency} = 0.98$  (control efficiency expressed as fraction)

2,000 is the unit conversion factor lb/ton

Therefore:

$$E_{condensate,tanks,VOC} = \frac{3.60}{2,000} \times [1 - 0 - 0.315 \times 1 \times 0.98]$$

$$E_{condensate,tanks,VOC} = 0.001244 \text{ [tons/bbl]}$$

Flaring Emissions:

VOC emissions from flaring of condensate tank vapors may then be calculated as follows:

$$E_{flare,tank} = P_{condensate} \times \left( Q_{condensate,tanks} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times \frac{EF \times HV}{1,000} \right) / 2,000$$

where:

$E_{flare,tank}$  is the county-wide flaring emissions of VOC from condensate tank controls [ton/yr]

$P_{condensate} = 275,892$  [bbl/yr]

$Q_{condensate,tank} = 0.037$  [MCF/bbl]

$F_{flare} = 0.315$  (fraction of condensate tanks with flares)

$C_{captured} = 1.0$  (capture efficiency expressed as fraction)

### Nonpoint Oil and Gas Emissions Estimation Tool

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$C_{efficiency} = 0.98$  (control efficiency expressed as fraction)

$EF = 0.66$  [lb/MMBtu]

$HV = 2,597$  [BTU/SCF]

2,000 [lb/ton]

1,000 (conversion factor)

Therefore:

$$E_{flare,tank} = 275,892 \times \left( 0.037 \times 0.315 \times (1.0) \times (0.98) \times \frac{0.66 \times 2,597}{1,000} \right) / 2,000$$

$$E_{flare,tank} = 2.71 \text{ [ton/yr]}$$

Total VOC emissions from all condensate tanks in Columbia County can be evaluated as follows:

$$E_{condensate,tanks,TOTAL} = E_{condensate,tanks,VOC} \times P_{condensate} \times F_{tank} + E_{flare,tanks}$$

where:

$E_{condensate,tanks,TOTAL}$  is the county-wide total emissions of VOC from condensate tanks [ton/yr]

$E_{condensate,tanks,VOC} = 0.0012$  [tons/bbl]

$P_{condensate} = 275,892$  [bbl/yr]

$F_{tank} = 1$  (fraction directed to tanks)

$E_{flare,tanks} = 2.71$  [ton/yr]

Therefore:

$$E_{condensate,tanks,TOTAL} = 0.001244 \times 275,892 \times 1 + 2.71$$

$$E_{condensate,tanks,TOTAL} = 345.9 \text{ [ton/yr]}$$

### 3.5 Crude Oil Tanks

Crude oil tanks are used to store liquid product at a well pad or central tank battery prior to transfer downstream to a refinery. Figure 3-4 shows a central tank battery (circled) in the Permian Basin adjacent to numerous well pads with pump jacks.<sup>2</sup>

Crude oil tank emissions are generated by working and breathing processes. The methodology for estimating oil tank venting emissions is shown in Equations 11-12. This methodology is based on a combined working and breathing losses VOC emissions factor on a per unit throughput basis (mass emissions per barrel of oil).

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<sup>2</sup> Google Earth, 2014. "Permian Basin Tank Battery." 32°28'16.26" N and 102°49'26.40" W. November 14, 2011. March 25, 2014.



**Figure 3-4. Permian Basin Tank Battery**

Equation 11)

$$E_{oil,tanks,VOC} = P_{oil} \times \frac{EF_{oil,tanks,VOC}}{2,000} \times F_{tank} \times [1 - F_{VRU} - F_{flare} \times C_{captured} \times C_{efficiency}]$$

where:

$E_{oil,tanks,VOC}$  is the county-wide annual VOC venting losses from oil tanks [tons-VOC/yr]

$P_{oil}$  is the annual county-wide oil production [bbl/yr]

$EF_{oil,tanks,VOC}$  is the VOC emissions factor for total losses from oil tanks [lb-VOC/bbl]

$F_{tank}$  is the fraction of oil directed to tanks [%]

$F_{VRU}$  is the fraction of oil tanks controlled by vapor recovery units

$F_{flare}$  is the fraction of oil tanks with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

2,000 is the unit conversion factor lb/ton

The methodology for estimating crude oil tank losses from other pollutants  $i$  in the emissions is shown below:

Equation 12)

$$E_{oil,tanks,i} = E_{oil,tanks,VOC} \times \frac{weigh\ fraction_i}{weight\ fraction_{VOC}}$$

## Nonpoint Oil and Gas Emissions Estimation Tool

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where:

$E_{oil,tanks,i}$  is the county-wide annual losses of pollutant  $i$  from oil tanks [tons/yr]  
 $E_{oil,tanks,VOC}$  is the county-wide annual VOC venting losses from oil tanks [tons-VOC/yr]  
( $weight\ fraction_i/weight\ fraction_{voc}$ ) is the mass-based weight fraction of pollutant  $i$  divided by the weight fraction of VOC in the gas

### Flaring emissions from oil tank controls

This source category includes any flaring emissions associated with controls applied to crude oil tanks. The methodology for estimating emissions from flaring of oil tank gas losses is described below:

$$\text{Equation 13) } E_{flare,tank,i} = P_{oil} \times \left( Q_{oil,tanks,flash} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times \frac{EF_i \times HV}{1,000} \right) / 2,000$$

where:

$E_{flare,tank,i}$  is the county-wide emissions from crude oil tank flaring [ton/yr]  
 $P_{oil}$  is the annual county-wide oil production [bbl/yr]  
 $Q_{oil,tanks,flash}$  is the volume of gas flared per unit of oil throughput [MCF/bbl]  
 $F_{flare}$  is the fraction of oil tanks with flares  
 $C_{captured}$  is the capture efficiency of the flare  
 $C_{efficiency}$  is the control efficiency of the flare  
 $EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]  
 $HV$  is the local heating value of the gas [BTU/SCF]  
1,000 is the unit conversion factor MCF/MMCF  
2,000 is the unit conversion factor lb/ton

The methodology for estimating SO<sub>2</sub> emissions from flaring of oil tank losses is shown below:

Equation 14)

$$E_{flare,tank,SO_2} = \left( \frac{P \times (Q_{oil,tanks,flash} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times P_{oil})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times f_{H_2S} \times 2 / 907,185$$

where:

$E_{flare,tank,SO_2}$  is the county-wide SO<sub>2</sub> emissions from flaring controls in oil tanks [ton/yr]  
 $P$  is atmospheric pressure [1 atm]  
 $Q_{oil,tank,flash}$  is the volume of gas vented per unit of oil throughput [MCF/bbl]  
 $F_{flare}$  is the fraction of crude oil tanks with flares  
 $C_{captured}$  is the capture efficiency of the flare

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$C_{efficiency}$  is the control efficiency of the flare  
 $P_{oil}$  is the annual county-wide oil production [bbl/yr]  
 $R$  is the universal gas constant [0.082 L-atm/mol-K]  
 $MW_{gas}$  is the molecular weight of the gas [g/mol]  
 $T$  is the atmospheric temperature [298 K]  
 $f_{H_2S}$  is the mass fraction of H<sub>2</sub>S in the gas  
 $3.5 \times 10^{-5}$  is the unit conversion factor MCF/L  
907,185 is the unit conversion factor g/ton

#### Extrapolation to county-level emissions

Equations 11-14 provide county-wide estimates directly using by-county oil production as a surrogate. The total county-wide emissions from crude oil tanks are the sum of flaring and crude tank working and breathing emissions (by-pollutant).

#### Example Calculation for Crude Oil Tanks:

Using the equations provided above, VOC emissions for crude oil tanks in Columbia County, Arkansas were calculated as follows:

$$E_{oil,tanks,VOC} = P_{oil} \times \frac{EF_{oil,tanks,VOC}}{2,000} \times F_{tank} \times [1 - F_{VRU} - F_{flare} \times C_{captured} \times C_{efficiency}]$$

where:

$E_{oil,tanks,VOC}$  is the county-wide annual VOC venting losses from oil tanks [tons-VOC/yr]  
 $P_{oil} = 1,231,945$  [bbl/yr]  
 $EF_{oil,tanks,VOC} = 0.287$  [lb-VOC/bbl]  
 $F_{tank} = 1$  (fraction directed to tanks)  
 $F_{VRU} = 0$  (fraction controlled by VRU)  
 $F_{flare} = 0$  (fraction flared)  
 $C_{captured} = 1.0$  (capture efficiency expressed as fraction)  
 $C_{efficiency} = 0.98$  (control efficiency expressed as fraction)  
2,000 [lb/ton]

Therefore:

$$E_{oil,tanks,VOC} = 1,231,945 \times \frac{0.287}{2,000} \times [1 - 0 - 0 \times 1.0 \times 0.98]$$

$$E_{oil,tanks,VOC} = 177 \text{ [tons-VOC/yr]}$$

Flaring emissions are calculated similarly to the example given above for condensate tanks. In this case, since the fraction of crude oil tank vapors sent to flares is zero, there are no flare emissions.

### **3.6 Dehydrators**

This source category refers to wellhead dehydrator units. Dehydrator units are used to remove excess water from produced natural gas prior to delivery to the pipeline or to a gas processing plant. Two main sources of emissions are found in a dehydrator device: hydrocarbon emissions (including VOC and HAPs) are generated in the dehydrator still vent, and combustion emissions are generated in the dehydrator reboiler. In addition, if dehydrator still vents are controlled by flare, combustion emissions from flaring controls contribute to the total dehydrator emissions. Figure 3-5 shows a glycol dehydrator in the Barnett shale.



**Figure 3-5. Dehydrator**

The basic methodology for estimating county-wide emissions from dehydrator still vents is shown in Equation 15:

Equation 15) 
$$E_{stillvent,VOC} = P_{gas} \times \frac{EF_{stillvent}}{1,000 \times 2,000} \times [1 - F_{flare} \times C_{captured} \times C_{efficiency}]$$

## **Nonpoint Oil and Gas Emissions Estimation Tool**

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where:

$E_{stillvent,VOC}$  is the county-wide VOC emissions from dehydrator still vents [ton/yr]  
 $P_{gas}$  is the annual county-wide gas production [MCF/yr]  
 $EF_{stillvent}$  is the VOC emission factor for dehydrator still vent per unit of gas throughput [lb-VOC/MMCF]  
 $F_{flare}$  is the fraction of dehydrator vents with flares  
 $C_{captured}$  is the capture efficiency of the flare  
 $C_{efficiency}$  is the control efficiency of the flare  
2,000 is the unit conversion factor lb/ton  
1,000 is the unit conversion factor MCF/MMCF

The methodology for estimating dehydrator still vent emissions from other pollutants  $i$  is shown below:

Equation 16) 
$$E_{stillvent,i} = E_{stillvent,VOC} \times \frac{weight\ fraction_i}{weight\ fraction_{VOC}}$$

where:

$E_{stillvent,i}$  is the county-wide emissions of pollutant  $i$  from dehydrator still vents [ton/yr]  
 $E_{stillvent,VOC}$  is the county-wide VOC emissions from dehydrator still vents [ton/yr]  
 $(weight\ fraction_i/weight\ fraction_{VOC})$  is the mass-based weight fraction of pollutant  $i$  divided by the weight fraction of VOC in the vented gas

The basic methodology for estimating emissions for the dehydrator reboiler is equivalent to that of a standard field heater:

Equation 17) 
$$E_{reboiler,i} = N \times \frac{EF_i \times Q_{reboiler} \times t_{annual} \times hc}{HV \times 2,000} \times W_{gas}$$

where:

$E_{reboiler,i}$  is the county-wide emissions from pollutant  $i$  from dehydrator reboilers [ton/yr]  
 $N$  is the number of dehydrators per well [1/well]  
 $EF_i$  is the emission factor for pollutant  $i$  for natural gas-fired small boilers [lb/MMCF]  
 $Q_{reboiler}$  is the heater size [MMBtu/hr]  
 $t_{annual}$  is the annual hours of operation [hr]  
 $hc$  is a heater cycling fraction of operating hours that the heater is firing  
 $HV$  is the local natural gas heating value [Btu<sub>local</sub>/SCF]  
 $W_{gas}$  is the county-wide number of active gas wells in a particular year [well/yr]  
2,000 is the unit conversion factor lb/ton

### **Flaring emissions from dehydrator venting controls**

The methodology for estimating county-wide emissions from flaring of dehydrator still vent gas is described below:

Equation 18)

$$E_{flare,dehy,i} = \left( P_{gas} \times Q_{dehydrator,vent} \times F_{flare} \times (C_{captured}) \times (C_{efficiency}) \times \frac{EF_i \times HV}{10^6} \right) / 2,000$$

where:

$E_{flare,dehy,i}$  is the county-wide emissions of pollutant  $i$  from dehydrator vent gas flaring [ton/yr]

$P_{gas}$  is the annual county-wide gas production [MCF/yr]

$Q_{dehydrator,vent}$  is the volume of gas flared per unit of gas throughput in dehydrator [MCF vented/MMCF natural gas]

$F_{flare}$  is the fraction of dehydrators with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]

$HV$  is the local heating value of the gas [BTU/SCF]

2,000 is the unit conversion factor lb/ton

$10^6$  is the unit conversion factor SCF/MMCF

The methodology for estimating SO<sub>2</sub> emissions from flaring of dehydrator vent gas is shown below:

Equation 19)

$$E_{flare,dehydrator,SO_2} = P \times \left( \frac{P_{gas} \times Q_{dehydrator,vent} \times F_{flare} \times (C_{captured}) \times (C_{efficiency})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times f_{H_2S} \times 2/907,185$$

where:

$E_{flare,dehydrator,SO_2}$  is the county-wide SO<sub>2</sub> flaring emissions from flaring of dehydrator vent gas [ton/yr]

$P$  is atmospheric pressure [1 atm]

$P_{gas}$  is the annual county-wide gas production [MCF/yr]

$Q_{dehydrator,vent}$  is the volume of gas flared per unit of gas throughput [MCF vented/MMCF natural gas]

$F_{flare}$  is the fraction of dehydrators with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the dehydrator venting gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{H_2S}$  is the mass fraction of H<sub>2</sub>S in the dehydrator venting gas

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

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### **Extrapolation to county-level emissions**

Equations 15-19 provide direct county-level estimates of pollutant emissions from dehydrator still vents, reboilers, and flaring controls. Emissions of the same pollutant each of these three sub-categories should be added together to arrive at total county-level dehydrator emissions (still vent + reboiler + flaring).

### **Example Calculation for Dehydrators:**

Using the equations provided above, VOC emissions from the still vents and reboilers of dehydrators in Cleburne County, Arkansas were calculated as follows:

Still Vent emissions:

$$E_{stillvent,VOC} = P_{gas} \times \frac{EF_{stillvent}}{1,000 \times 2,000} \times [1 - F_{flare} \times C_{captured} \times C_{efficiency}]$$

where:

$E_{stillvent,VOC}$  is the county-wide VOC emissions from dehydrator still vents [ton/yr]

$P_{gas} = 139,458,888$  [MCF/yr]

$EF_{stillvent} = 0.528$  [lb-VOC/MMCF]

$F_{flare} = 0$  (fraction of dehydrator vents with flares)

$C_{captured} = 1.0$  (capture efficiency expressed as fraction)

$C_{efficiency} = 0.98$  (control efficiency expressed as fraction)

2,000 [lb/ton]

1,000 [MCF/MMCF]

Therefore:

$$E_{stillvent,VOC} = 139,458,888 \times \frac{0.528}{1,000 \times 2,000} \times [1 - 0 \times 1.0 \times 0.98]$$

$$E_{stillvent,VOC} = 36.8 \text{ [ton/yr]}$$

Flaring emissions are calculated similarly to the example given above for condensate tanks. In this case, since the fraction of still vent vapors sent to flares is zero, there are no flare emissions.

Reboiler emissions:

$$E_{reboiler, voc} = N \times \frac{EF_{VOC} \times Q_{reboiler} \times t_{annual} \times hc}{HV \times 2,000} \times W_{gas}$$

## Nonpoint Oil and Gas Emissions Estimation Tool

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where:

$E_{reboiler,VOC}$  is the county-wide emissions of VOC from dehydrator reboilers [ton/yr]

$N = 1$  [per well]

$EF_{VOC} = 5.5$  [lb/MMCF]

$Q_{reboiler} = 0.9875$  [MMBtu/hr]

$t_{annual} = 8,672.5$  [hr/yr]

$hc = 1$  (cycling fraction of operating hours that the heater is firing)

$HV = 1,035$  [Btu<sub>local</sub>/SCF]

$W_{gas} = 490$  [wells]

2,000 [lb/ton]

Therefore:

$$E_{reboiler,VOC} = 1 \times \frac{5.5 \times 0.9875 \times 8,672.5 \times 1}{1,035 \times 2,000} \times 490$$

$$E_{reboiler,VOC} = 11.15 \text{ [ton/yr]}$$

Total VOC emissions from dehydrators in Cleburne County can be evaluated as follows:

$$E_{dehy,VOC} = E_{stillvent,VOC} + E_{reboiler,VOC}$$

$$E_{dehy,VOC} = 36.8 \text{ [ton/yr]} + 11.15 \text{ [ton/yr]}$$

$$E_{dehy,VOC} = 48.0 \text{ [ton/yr]}$$

### 3.7 Drilling Rigs

Drilling rig emissions come from three primary engine types: Draw works, Mud pumps and Generators. Each of these three engine types is used for differing periods of time throughout the drilling process and are likely to have different load factor and sizes. Each of the three engines is also likely to be of differing model years and hence Tier levels. Some drilling rigs operate with a set of large generator engines which provides electric power to the other prime movers of the rig – draw works and mud pumps; these type of rigs are referred to here as diesel-electric rigs. Figure 3-6 shows a drilling rig in the Barnett shale.

In order to account for variations in engine characteristics and their effect in final emissions, average emissions for each type of engine  $k$  ( $k$ =drawworks, mud pumps or generators) is estimated separately. In addition, operation parameters such as time and load factor may vary for vertical, directional, and horizontal wellbores; hence emissions are estimated separately for both drilling methods using equations 20 and 21. Directional wells are included with vertical wells for purposes of the calculation.



**Figure 3-6. Drilling Rig**

Emissions for a single engine of type  $k$  are estimated according to Equation 20:

Equation 20) 
$$E_{\text{engine } k,i} = \frac{EF_i \times HP_k \times LF_k \times t_{\text{event}} \times n}{907,185}$$

where:

$E_{\text{engine } k,i}$  are emissions of pollutant  $i$  from an engine type  $k$  [ton/spud]

$EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr]

$HP_k$  is the horsepower for an engine  $k$  in the county [hp]

$LF_k$  is the load factor of the engine  $k$

$t_{\text{event}}$  is the number of hours engine  $k$  is used [hr/spud]

$n$  is the number of type- $k$  engines in the typical drill rig

907,185 is the mass unit conversion [g/ton]

## Nonpoint Oil and Gas Emissions Estimation Tool

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The emission factor for pollutant  $i$ ,  $EF_i$ , is an emissions factor derived from EPA's NONROAD2008 model and based on the representative population of drilling engine of various tier levels in NONROAD. The emissions factor for drill-rig equipment varies by horsepower range, and there are three possible horsepower bins applicable to the typical range of equipment sizes for drill rig engines. Hence, three sets of possible engine emissions factors (by HP) are used.

Emissions from a single drill rig ( $E_{drillrigTOTAL,i}$ ) are estimated in Equation 21 as the sum of individual emissions from each drill rig engine as calculated with Equation 20 in [tons/spud]:

Equation 21) 
$$E_{drillrigTOTAL,i} = \sum E_{engine\ k,i}$$

Two distinct drill-rig configurations may be found in various basins:

- Diesel-mechanical (D) drill rigs: in which all  $k$  engines are diesel-fueled
- Diesel-electric (DE) powered drill rigs: in which only the generator is powered by diesel and the draw works and mud pumps are electric (and thus do not have direct emissions associated with them)

Thus equations 20 and 21 will vary by these two configurations, and a set of input values for each the four combinations of vertical/horizontal wellbores and diesel/diesel-electric rigs must be applied.

Emissions from drill rigs correlate to the depth of the wellbore, which will vary between horizontal and vertical wellbores; thus emissions can be estimated on a “per foot drilled” basis using the equation below.

Equation 22) 
$$[E_{drilling,i}]_{vertical/horizontal} = \left[ \frac{E_{drillrigTOTAL,i_D} \times (1 - F_{DE}) + E_{drillrigTOTAL,i_{DE}} \times F_{DE}}{D_{spud}} \right] \frac{vertical}{horizontal}$$

where

$E_{drilling,i}$  is the total emissions for a horizontal or vertical spud per unit of feet drilled [tons/ft]

$E_{drillrigTOTAL,i_D}$  is the emissions from a single diesel-powered drill rig (from Equation 21) for a vertical or a horizontal spud [tons/spud]

$F_{DE}$  is the fraction of drill rigs that are diesel-electric

$E_{drillrigTOTAL,i_{DE}}$  is the emissions from a single diesel-electric drill rig (from Equation 21) for a vertical or a horizontal spud [tons/spud]

$D_{spud}$  is the depth of a vertical or horizontal spud [ft/spud]

## Nonpoint Oil and Gas Emissions Estimation Tool

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### Extrapolation to county-level emissions

Emissions per feet drilled are scaled to county-level drilling emissions according to Equation 23.

Equation 23)

$$E_{drill, county-wide, i} = [E_{drilling, i}]_{vertical} \times D_{vertical} + [E_{drilling, i}]_{horizontal} \times D_{horizontal}$$

where:

$E_{drill, county-wide, i}$  is the total emissions of pollutant  $i$  from county-wide drilling activity [tons/yr]

$E_{drilling, i}$  is the total emissions from drilling a single well [tons/ft]

$D_{vertical}$  is the total depth drilled in the county for vertical wells in a particular year [ft/yr]

$D_{horizontal}$  is the total depth drilled in the county for horizontal wells in a particular year [ft/yr]

### Example Calculation for Drill Rigs:

Drill rigs are classified as mechanical, or diesel electric. Mechanical rigs typically operate three types of engines during drilling: draw works engines (draw), mud pump engines (mud), and generator engines (gen). Diesel electric rigs are powered by a battery of diesel-electric generator engines. Wells are classified as vertical (a vertical wellbore), directional (a wellbore that is angled or deviates from vertical), and horizontal (after an initial vertical direction, the well is drilled horizontally). No vertical wells were drilled in Cleburne County, and there are no diesel electric rigs. Using the equations provided above, NO<sub>x</sub> emissions from drilling in Cleburne County, Arkansas were calculated as follows:

Emissions from a draw works engine during horizontal drilling:

$$E_{draw works} = \frac{EF \times HP \times LF \times t_{event} \times n}{907,185}$$

where:

$E_{draw works}$  = are emissions of NO<sub>x</sub> from a draw works engine [ton/spud]

$EF = 4.258$  [g/hp-hr]

$HP = 557.5$  [hp]

$LF = 0.4$  (load factor for the engine)

$t_{event} = 200$  [hr/spud]

$n = 2$  (number of draw work engines in the typical drill rig)

907,185 [g/ton]

Therefore:

$$E_{draw works} = \frac{4.258 \times 557.5 \times 0.4 \times 200 \times 2}{907,185}$$

$$E_{draw works} = 0.42 \text{ [ton /spud]}$$

### **Nonpoint Oil and Gas Emissions Estimation Tool**

Using similar methodology, emissions for mud pump and generator engines during horizontal drilling were calculated to yield:

$$E_{draw\ works} = 0.42 \text{ [ton /spud]}$$

$$E_{mud\ pump} = 0.90 \text{ [ton /spud]}$$

$$E_{generator} = 1.19 \text{ [ton /spud]}$$

Total NO<sub>x</sub> emissions from all drill rig engines per spud can be evaluated as follows:

$$E_{drillrigTOTAL} = \sum E_{engine}$$

$$E_{drillrigTOTAL} = 2.51 \text{ [ton /spud]}$$

Total NO<sub>x</sub> emissions on a per foot basis are then calculated using:

$$[E_{drilling}]_{vertical/horizontal} = \left[ \frac{E_{drillrigTOTAL,D} \times (1 - F_{DE}) + E_{drillrigTOTAL,DE} \times F_{DE}}{D_{spud}} \right] \frac{vertical}{horizontal}$$

where

$E_{drilling}$  is the total emissions for a horizontal or vertical spud per unit of feet drilled [tons/ft]

$$E_{drillrigTOTAL,D} = 2.51 \text{ [ton /spud]}$$

$F_{DE} = 0$  (fraction of drill rigs that are diesel-electric)

$$E_{drillrigTOTAL,DE} = 0 \text{ [ton /spud]}$$

$$D_{spud} = 9,318.1 \text{ [ft/spud]}$$

Therefore:

$$E_{drilling,horizontal} = \frac{2.51 \times (1-0) + (0 \ 0)}{9,318.1}$$

$$E_{drilling,horizontal} = 0.0002693 \text{ [ton /ft]}$$

Finally, county-wide emissions may be calculated as follows:

$$E_{drill,county-wide} = [E_{drilling}]_{vertical} \times D_{vertical} + [E_{drilling}]_{horizontal} \times D_{horizontal}$$

where:

$E_{drill,county-wide}$  is the total emissions of NO<sub>x</sub> from county-wide drilling activity [ton/yr]

$$E_{drilling,vertical} = 0 \text{ [tons/ft]}$$

$$D_{vertical} = 0 \text{ [ft/yr]}$$

$$E_{drilling,horizontal} = 0.0002693 \text{ [tons/ft]}$$

$$D_{horizontal} = 596,026.5 \text{ [ft/yr]}$$

Therefore:

$$E_{drill, county-wide} = 0.00002693 \times 596,026.5$$

$$E_{drill, county-wide} = 160.55 \text{ [ton /yr]}$$

### 3.8 Fugitive Leaks

This source category refers to leaking emissions of produced gas that escape through well site and pipeline components such as connectors, flanges, open-ended lines, valves, and compressor wet seals. It must be noted that this source category refers only to fugitive emissions components located at the wellhead and that large transmission pipeline fugitives and other midstream fugitives sources are not part of this analysis. Figure 3-7 shows numerous flanges (circled) and a series of separators at a multi-well pad in the Marcellus shale.<sup>1</sup>



**Figure 3-7. Flanges**

Fugitive emissions for an individual typical well are estimated according to Equation 24:

Equation 24) 
$$E_{fugitive,j} = (\sum_i EF_i \times N_i \times t_{annual} \times Y_j) / 907.185$$

where:

$E_{fugitive,j}$  is the fugitive emissions for a single typical well for pollutant  $j$  [ton/yr/well]  
 $EF_i$  is the emission factor of TOC for a single component  $i$  [kg/hr/component]

### Nonpoint Oil and Gas Emissions Estimation Tool

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$N_i$  is the total number of components of type  $i$

$t_{annual}$  is the annual number of hours the well is in operation [8760 hr/yr]

$Y_j$  is the mass ratio of pollutant  $j$  to TOC in the vented gas

907.185 is the unit conversion factor kg/ton

In addition, fugitive leaks from wellhead compressor seals can be estimated from the following equations:

$$\text{Equation 25) } E_{\text{compressor, fug, CH}_4} = \left( \frac{P \times (V_{\text{vented}}) \times t}{\left( \frac{R}{MW_{\text{gas}}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{(f_{\text{wellhead}} + 1 / N_{\text{lateral}})}{907,185 * 1,000} \times W_{\text{gas}}$$

where:

$E_{\text{compressor, fug, CH}_4}$  is the county-wide CH<sub>4</sub> fugitive emissions from compressor seals [ton/yr]

$P$  is atmospheric pressure [1 atm]

$V_{\text{vented}}$  is the volume of leaked gas per compressor [SCF/compressor/hour]

$t$  is the annual hours of operation for wellhead compressors [hrs/yr]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{\text{gas}}$  is the molecular weight of the pollutant [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{\text{wellhead}}$  is the fraction of wells with wellhead compressors

$N_{\text{lateral}}$  is the number of gas wells served by a lateral compressor engine

$W_{\text{gas}}$  is the county-wide number of gas wells

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

1,000 is the unit conversion factor SCF/MCF

To estimate emissions of other pollutants (VOC, H<sub>2</sub>S) the following equation may be used:

$$\text{Equation 26) } E_{\text{compressor, fug, } i} = E_{\text{compressor, fug, CH}_4} \times \frac{MW_i}{MW_{\text{CH}_4}} \times \frac{M_i}{M_{\text{CH}_4}}$$

where:

$E_{\text{compressor, fug, } i}$  is the county-wide compressor fugitive emissions for pollutant  $i$  [ton/yr]

$E_{\text{compressor, fug, CH}_4}$  is the compressor fugitive emissions for CH<sub>4</sub> [ton CH<sub>4</sub>/yr]

$MW_i$  is the molecular weight of pollutant  $i$  [lb/lb-mol]

$MW_{\text{CH}_4}$  is the molecular weight of CH<sub>4</sub> [lb/lb-mol]

$M_{\text{CH}_4}$  is the mole percent of CH<sub>4</sub> in the local gas [%]

$M_i$  is the mole percent of pollutant in the local gas [%]

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### **Extrapolation to county-level emissions**

County-wide fugitive emissions from well-site piping components are estimated according to Equation 27:

Equation 27) 
$$E_{fugitive, TOTAL} = E_{fugitive, j} \times N_{well}$$

where:

$E_{fugitive, TOTAL}$  is the total fugitive emissions from well-site piping components in the county [ton/yr]

$E_{fugitive, j}$  is the fugitive emissions for a single well of pollutant  $j$  [ton/yr/well] (from Equation 24)

$N_{well}$  is the total number of active wells in the county [wells]

Total county-wide fugitive emissions are the sum of compressor seal emissions and component fugitive emissions.

### **Example Calculation for Fugitive Leaks:**

Fugitive emissions at gas well and oil well sites occur from connectors, flanges, open-ended lines, compressor seals, and valves. Using the equations provided above, VOC emissions for fugitive leaks from valves at gas wells in Cleburne County, Arkansas were calculated as follows:

$$E_{fugitive} = (\sum_i EF \times N \times t_{annual} \times Y) / 907.185$$

where:

$E_{fugitive}$  is the VOC emissions for a single gas well from valves [ton/yr/well]

$EF = 0.0045$  [kg TOC/hr/valve]

$N = 12$  [valves/well]

$t_{annual} = 8,760$  [hr/yr]

$Y = 0.036$  [VOC to TOC ratio]

907.185 [kg/ton]

Therefore:

$$E_{fugitive} = (0.0045 \times 12 \times 8,760 \times 0.036) / 907.185$$

$$E_{fugitive} = 0.0188 \text{ [ton/well]}$$

Total VOC emissions from fugitive leaks from valves at gas wells in Cleburne County were calculated as follows:

## Nonpoint Oil and Gas Emissions Estimation Tool

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$$E_{fugitive,TOTAL} = E_{fugitive} \times N_{well}$$

where:

$E_{fugitive,TOTAL}$  is the total fugitive emissions from valves in Cleburne County [ton/yr]

$E_{fugitive} = 0.0188$  [ton/yr/well]

$N_{well} = 490$  [wells]

Therefore:

$$E_{fugitive,TOTAL} = 0.0188 \times 490$$

$$E_{fugitive,TOTAL} = 9.21 \text{ [ton/yr]}$$

### 3.9 Gas-Actuated Pumps

Gas-actuated pumps refer to small gas-driven plunger pumps used at oil and gas production sites, to provide a constant supply of chemicals or lubricants to specific flow lines or equipment. These are regularly used in sites where electric power is unavailable. As part of their operation, gas-driven pumps vent part of the driving gas to the atmosphere, making them a VOC and CH<sub>4</sub> emissions source. Two types of gas-actuated pumps were considered: Kimray pumps and chemical injection pumps (CIP). For oil wells only CIPs are assumed to be used. Annual vented gas rates per well from Kimray pumps are estimated following Equation 28:

$$\text{Equation 28) } E_{kimray,CH_4} = \frac{EF_{CH_4}}{907,185} \times Q_{kimray} \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{kimray,CH_4}$  is the per-well CH<sub>4</sub> emissions from Kimray pumps [tons- CH<sub>4</sub>/well-yr]

$EF_{CH_4}$  is the CH<sub>4</sub> emissions factor for a Kimray pump per unit throughput [SCF-CH<sub>4</sub>/MMCF]

$Q_{kimray}$  is the gas pumped per well annually with Kimray pumps [MMCF/well-yr]

$P$  is the atmospheric pressure [1 atm]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of CH<sub>4</sub> [g/mol]

$T$  is the atmospheric temperature [298 K]

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

1,000 is the unit conversion factor SCF/MCF

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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Emissions from CIPs are estimated based on Equation 29:

Equation 29) 
$$E_{CIP,CH_4} = \frac{EF_{CH_4}}{907,185} \times N_{CIP} \times \frac{t_{CIP}}{24} \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{CH_4}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{CIP,CH_4}$  is the per-well CH<sub>4</sub> emissions from CIP pumps [tons- CH<sub>4</sub>/well-yr]

$EF_{CH_4}$  is the CH<sub>4</sub> emissions factor for a CIP pump [SCF- CH<sub>4</sub>/pump/day]

$N_{CIP}$  is the number of CIPs per well [pump/well]

$t_{CIP}$  is the regular operation time for chemical injection pumps [hrs/yr]

$P$  is the atmospheric pressure [1 atm]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{CH_4}$  is the molecular weight of CH<sub>4</sub> [g/mol]

$T$  is the atmospheric temperature [298 K]

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

1,000 is the unit conversion factor SCF/MCF

To estimate emissions from other pollutants (VOC, CO<sub>2</sub>, H<sub>2</sub>S, HAPs) from Kimray and CIP pumps, the following equation may be used:

Equation 30) 
$$E_{pump,i} = E_{pump,CH_4} \times \frac{MW_i}{MW_{CH_4}} \times \frac{M_i}{M_{CH_4}}$$

where:

$E_{pump,i}$  is the emissions for pollutant i per well from CIPs or Kimray Pumps [ton/well-yr]

$E_{pump,CH_4}$  is the CH<sub>4</sub> emissions from CIPs or Kimray Pumps [ton CH<sub>4</sub>/well-yr] (from Equations 28 or 29)

$MW_i$  is the molecular weight of pollutant i [lb/lb-mol]

$MW_{CH_4}$  is the molecular weight of CH<sub>4</sub> [lb/lb-mol]

$M_{CH_4}$  is the mole percent of CH<sub>4</sub> in the local gas vented from the pump [%]

$M_i$  is the mole percent of pollutant in the local gas vented from the pump [%]

### **Extrapolation to county-level emissions**

To estimate county-wide annual emissions from gas-actuated pumps for each pollutant, the scaling surrogate used is well counts, according to Equation 31:

Equation 31)

$$E_{GAP, i} = [(E_{CIP, i} + E_{kimray,i}) \times W_{gas}]_{gas\ wells} + [E_{CIP, i} \times W_{oil}]_{oil\ wells}$$

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where:

$E_{GAP, i}$  is the annual county-wide emissions for pollutant  $i$  from gas-actuated pumps [ton/yr]  
 $E_{CIP, i}$  is the emissions from chemical injection pumps per well type (gas or oil) [ton/yr-well]  
 $E_{kimray, i}$  is the emissions from kimray pumps per well [ton/yr-well]  
 $W_{gas}$  is the number of active gas wells in a particular county [wells]  
 $W_{oil}$  is the number of active oil wells in a particular county [wells]

### Example Calculation for Gas-Actuated Pumps:

Using the equations provided above, VOC emissions for gas-actuated pumps in Cleburne County, Arkansas were calculated as follows:

#### Kimray Pumps

$$E_{kimray, CH_4} = \frac{EF_{CH_4}}{907,185} \times Q_{kimray} \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{CH_4}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{kimray, CH_4}$  is the per-well  $CH_4$  emissions from Kimray pumps at gas wells [tons- $CH_4$ /well-yr]  
 $EF_{CH_4} = 1,041$  [SCF-  $CH_4$ /MMCF]  
 $Q_{kimray} = 42.9$  [MMCF/well-yr]  
 $P = 1$  [atm]  
 $R = 0.082$  [L-atm/mol-K]  
 $MW_{CH_4} = 16.04$  [g/mol]  
 $T = 298$  [K]  
907,185 [g/ton]  
1,000 [SCF/MCF]  
 $3.5 \times 10^{-5}$  [MCF/L]

Therefore:

$$E_{kimray, CH_4} = \frac{1,041}{907,185} \times 42.9 \times \frac{1}{1,000 \times \left( \left( \frac{0.082}{16.04} \right) \times 298 \times 3.5 \times 10^{-5} \right)}$$

$$E_{kimray, CH_4} = 0.923 \text{ [tons } CH_4/\text{well/yr]}$$

VOC emissions are then calculated using:

$$E_{kimray} = E_{kimray, CH_4} \times \frac{MW_{VOC}}{MW_{CH_4}} \times \frac{M_{VOC}}{M_{CH_4}}$$

where:

$E_{kimray}$  is the emissions of VOC per well from Kimray Pumps [ton/well-yr]  
 $EF_{kimray, CH_4} = 0.923$  [ton  $CH_4$ /well-yr]  
 $MW_{VOC} = 52.1$  [lb/lb-mol]

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$$MW_{CH_4} = 16.04 \text{ [lb/lb-mol]}$$

$$M_{CH_4} = 0.94 \text{ [percent CH}_4\text{, expressed as a fraction]}$$

$$M_{VOC} = 0.01 \text{ [percent VOC, expressed as a fraction]}$$

Therefore:

$$E_{kimray} = 0.923 \times \frac{52.1}{16.04} \times \frac{0.01}{0.94}$$

$$E_{kimray} = 0.032 \text{ [ton/well-yr]}$$

### **Chemical Injection Pumps**

$$E_{CIP,CH_4} = \frac{EF_{CH_4}}{907,185} \times N_{CIP} \times \frac{t_{CIP}}{24} \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{CH_4}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{CIP,CH_4}$  is the per-well CH<sub>4</sub> emissions from CIP pumps at gas wells [tons- CH<sub>4</sub>/well-yr]

$EF_{CH_4} = 260$  [SCF- CH<sub>4</sub>/pump/day]

$N_{CIP} = 0.142$  [pump/well]

$t_{CIP} = 8,760$  [hrs/yr]

$P = 1$  [atm]

$R = 0.082$  [L-atm/mol-K]

$MW_{CH_4} = 16.04$  [g/mol]

$T = 298$  [K]

907,185 [g/ton]

1,000 [SCF/MCF]

$3.5 \times 10^{-5}$  [MCF/L]

Therefore:

$$E_{CIP,CH_4} = \frac{260}{907,185} \times 0.142 \times \frac{8,760}{24} \times \frac{P}{1,000 \times \left( \left( \frac{0.082}{16.04} \right) \times 298 \times 3.5 \times 10^{-5} \right)}$$

$$E_{CIP,CH_4} = 0.279 \text{ [tons CH}_4\text{/well/yr]}$$

Using the same methodology as above for Kimray pumps, VOC emissions from CIP pumps are estimated as:

$$E_{CIP} = 0.011 \text{ [ton/well/yr]}$$

Total VOC emissions from all gas-actuated pumps in Cleburne County can be evaluated as follows:

$$E_{GAP} = [(E_{CIP} + E_{kimray}) \times W_{gas}]_{gas\ wells} + [E_{CIP} \times W_{oil}]_{oil\ wells}$$

where:

$E_{GAP}$  is the annual county-wide VOC emissions from gas-actuated pumps [ton/yr]

$E_{CIP} = 0.011$  [ton/yr-well]

$E_{kimray} = 0.032$  [ton/yr-well]

$W_{gas} = 490$  [wells]

$W_{oil} = 0$  [wells]

Therefore:

$$E_{GAP} = [(0.011 + 0.032) \times 490]_{gas\ wells} + [0.011 \times 0]_{oil\ wells}$$

$$E_{GAP} = 21.1 \text{ [ton/yr]}$$

### 3.10 Heaters

This category refers to natural gas-fired external combustors used in oil and gas production facilities to provide heat input to separators (separator heaters or heater treaters), to prevent the formation of hydrates during pressure reductions (line heaters), or to provide heat to tanks (tank heaters). This category does not refer to reboilers used in dehydrators as those emissions are captured in the dehydrator source category. Figure 3-8 shows a line heater at a natural gas well in the Marcellus shale.<sup>1</sup>



**Figure 3-8. Line Heater**

The basic methodology for estimating emissions for all pollutants except SO<sub>2</sub> for a single heater is shown in Equation 32. Local fuel gas properties will vary between gas wells and oil wells; hence emissions are estimated separately for this category. Due to limited field data for this category, all other parameters unrelated to local gas composition were assumed to be the same for gas and oil wells.

Equation 32) 
$$E_{heater} = \frac{EF_{heater} \times Q_{heater} \times t_{annual} \times hc}{(HV \times 2,000)}$$

where:

$E_{heater}$  is the emissions from a given heater [ton/yr]

$EF_{heater}$  is the emission factor for a heater for a given pollutant [lb/million SCF]

$Q_{heater}$  is the heater MMBTU/hr rating [MMBTU<sub>rated</sub>/hr]

$t_{annual}$  is the annual hours of operation [hr/yr]

$hc$  is a heater cycling fraction to account for the fraction of operating hours that the heater is firing (if not available,  $hc=1$ )

$HV$  is the local natural gas heating value [BTU<sub>local</sub>/SCF]

2,000 is the unit conversion factor lb/ton

The methodology for estimating SO<sub>2</sub> emissions from heaters requires first estimating the mass of gas combusted in the heater, and then uses the mass fraction of H<sub>2</sub>S in the gas and the assumption that all H<sub>2</sub>S is converted to SO<sub>2</sub>. This methodology is described in Equation 33.

Equation 33)

$$E_{heater,SO_2} = \frac{2 \times f_{H_2S}}{907,185} \times \left( \frac{Q_{heater} \times t_{annual} \times hc}{(HV)} \times \frac{P}{\left( \left( \frac{R}{MW_{gas}} \right) \times T \times 0.035 \right)} \right)$$

where:

$E_{heater,SO_2}$  is the SO<sub>2</sub> emissions from a given heater [ton-SO<sub>2</sub>/yr]

$f_{H_2S}$  is the mass fraction of H<sub>2</sub>S in the gas

$Q_{heater}$  is the heater MMBTU/hr rating [MMBTU<sub>rated</sub>/hr]

$t_{annual}$  is the annual hours of operation [hr/yr]

$hc$  is a heater cycling fraction to account for the fraction of operating hours that the heater is firing

$HV$  is the local natural gas heating value [MMBTU<sub>local</sub>/scf]

$P$  is atmospheric pressure [1 atm]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$3.5 \times 10^{-3}$  is the unit conversion factor SCF/L

907,185 is the unit conversion factor g/ton

1,000 is the unit conversion factor SCF/MCF

#### Extrapolation to county-level emissions

County-wide heater emissions are estimated by determining the typical number of heaters per well and scaling up by well count. This is shown in Equation 34:

Equation 34)

$$E_{heater,TOTAL} = E_{heater} \times N_{heater} \times W_{TOTAL}$$

where:

$E_{heater,TOTAL}$  is the total heater emissions in a county for a specific pollutant [ton/yr]

$E_{heater}$  is the total emissions from a single heater for a specific pollutant [ton/yr]

$N_{heater}$  is the typical number of heaters per well throughout in the county

$W_{TOTAL}$  is the total number of wells in the county

#### Example Calculation for Heaters - Gas:

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Using the equations provided above, NO<sub>x</sub> emissions from heaters at gas wells in Cleburne County, Arkansas were calculated as follows:

$$E_{heater} = \frac{EF_{heater} \times Q_{heater} \times t_{annual} \times hc}{(HV \times 2,000)}$$

where:

$E_{heater}$  = emissions from a single heater [ton /yr]

$EF_{heater}$  = 100 [lb NO<sub>x</sub>/MMCF]

$Q_{heater}$  = 0.61 [MMBtu/hr]

$t_{annual}$  = 8,760 [hr/yr]

$hc$  = 1 (heater cycling fraction of operating hours that the heater is firing)

$HV$  = 1,035 [MMBtu/MMCF]

2,000 [lb/ton]

Therefore:

$$E_{heater} = \frac{100 \times 0.61 \times 8,760 \times 1}{(1,035 \times 2,000)}$$

$$E_{heater} = 0.258 \text{ [ton/heater/yr]}$$

Total NO<sub>x</sub> emissions from all heaters in Cleburne County can be evaluated as follows:

$$E_{heater, TOTAL} = E_{heater} \times N_{heater} \times W_{TOTAL}$$

where:

$E_{heater, TOTAL}$  = total emissions from heaters [ton/yr]

$E_{heater}$  = 0.258 [ton/heater/yr]

$N_{heater}$  = 0.5 [heaters/well]

$W_{TOTAL}$  = 490 [wells]

Therefore:

$$E_{heater, TOTAL} = 0.258 \times 0.5 \times 490$$

$$E_{heater, TOTAL} = 63.21 \text{ [ton/yr]}$$

### **3.11 Hydraulic Fracturing Pumps**

This category refers to equipment used in hydraulic fracturing practices during well completions and recompletions, generally related to unconventional oil and gas production such as shale gas and tight sands oil/gas. Engines used during hydraulic fracturing are generally large diesel-fueled pumps that can be a significant NO<sub>x</sub> emissions source. Figure 3-9 shows hydraulic fracturing of three wells in the Marcellus shale.<sup>1</sup> The hydraulic fracturing pump engines are lined up on the red tractor trailer rigs.



**Figure 3-9. Hydraulic Fracturing**

Average emissions factors for hydraulic fracturing engines were derived from EPA's NONROAD2008 model based on the oil equipment source category bin in NONROAD. The basic methodology for estimating exhaust emissions from engines used at a hydraulic fracturing event is shown below:

Equation 35) 
$$E_{fracing,event,i} = n \times \frac{EF_i \times HP \times LF \times N_{stages} \times t_{stage}}{907,185}$$

where:

$E_{fracing,event}$  is the exhaust emissions for pollutant  $i$  from a single fracing event [ton/event]

$n$  is the number of engines used per fracing event

$EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr]

$HP$  is the horsepower of the engine [hp]

$LF$  is the load factor of the engine

$N_{stages}$  is the number of stages per fracing event [stage/event]

$t_{stage}$  is the duration of the fracturing stage [hr/stage]

907,185 is the unit conversion factor g/ton

#### Extrapolation to county-level emissions

Fracing pump emissions can be scaled up to the county level on the basis of horizontal spuds. It is assumed that hydraulic fracturing is performed in all horizontal spuds and thus the

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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methodology for scaling up fracturing pump engine emissions is based on this surrogate as shown below:

$$\text{Equation 36)} \quad E_{\text{frac,pumps,TOTAL}} = N_{\text{events}} \times E_{\text{fracing,event}}$$

where:

$E_{\text{frac,pump,TOTAL}}$  is the total emissions from fracing pump engines in the county [ton/yr]  
 $N_{\text{events}}$  is the number of unconventional well completions in a particular year [spuds/yr]  
 $E_{\text{fracing,event}}$  is the total exhaust emissions from engines in a single fracing event [ton/event]

#### **Example Calculation for Hydraulic Fracturing Pumps:**

Using the equations provided above, NO<sub>x</sub> emissions from hydraulic fracturing pumps in Cleburne County, Arkansas were calculated as follows:

$$E_{\text{fracing,event},i} = n \times \frac{EF_i \times HP \times LF \times N_{\text{stages}} \times t_{\text{stage}}}{907,185}$$

where:

$E_{\text{fracing,event},i}$  = emissions from a single fracturing event [ton/event]  
 $n = 8.5$  [engines/event]  
 $EF = 5.831$  [g/hp-hr]  
 $HP = 2,033$  [hp]  
 $LF = 0.688$  (load factor for the engine)  
 $N_{\text{stages}} = 10.5$  [stages/event]  
 $t_{\text{stage}} = 2.25$  [hr/stage]  
907,185 [g/ton]

Therefore:

$$E_{\text{fracing}} = 8.5 \times \frac{5.831 \times 2,033 \times 0.688 \times 10.5 \times 2.25}{907,185}$$

$$E_{\text{fracing}} = 1.81 \text{ [ton/event]}$$

Total NO<sub>x</sub> emissions from all hydraulic fracturing pumps in Cleburne County can be evaluated as follows:

$$E_{\text{fracing,TOTAL}} = E_{\text{fracing}} \times N_{\text{events}}$$

where:

$E_{\text{fracing,TOTAL}}$  = total emissions from hydraulic fracturing pumps in a county [ton/yr]  
 $E_{\text{fracing}} = 1.81$  [ton/event]  
 $N_{\text{events}} = 133$  [spuds/yr]

Therefore:

$$E_{fracing, TOTAL} = 1.81 \times 133$$

$$E_{fracing, TOTAL} = 241 \text{ [ton/yr]}$$

### **3.12 Lateral/Gathering Compressor Engines**

Lateral compressor engines are used to gather gas from multiple individual wells, generally serving groups of approximately 10 to 100 wells. These engines are generally medium size and larger than wellhead compressor engines, but often not large enough to trigger Title V or other major source permitting requirements. Lateral compressor engines were categorized into two main categories and thus emissions are estimated for each type of engine and consequently extrapolated to county-wide emissions. These categories of compressors are:

- Rich burn compressors
- Lean burn compressors

Figure 3-10 shows a large, lateral compressor engine operating in the Barnett shale.



**Figure 3-10. Lateral Compressor Engine**

The basic methodology for estimating emissions from lateral compressor engines is shown in Equation 37:

Equation 37) 
$$E_{engine, type} = \frac{EF_i \times HP \times LF \times t_{annual}}{907,185} \times (1 - F_{controlled} \times CF_i)$$

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where:

$E_{engine,type}$  are emissions from a particular type (rich vs. lean) of compressor engine [ton/yr/engine]  
 $EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr] (note that this value may differ between rich-burn vs. lean-burn engines)  
 $HP$  is the horsepower of the engine [hp]  
 $LF$  is the load factor of the engine  
 $t_{annual}$  is the annual number of hours the engine is used [hr/yr]  
 $F_{controlled}$  is the fraction of lateral compressors of a particular type that are controlled  
 $CF_i$  is the control factor for controlled engines for pollutant  $i$   
907,185 is the unit conversion factor g/ton

### Extrapolation to county-level emissions

County-level emissions are represented by a mix of the two types of lateral compressors. Single engine emissions are scaled to county level using the fraction ( $F$ ) of these engine types to total engines, the fraction of wells served by lateral compressor engines, and the total gas well count in a county, according to equation below:

$$\text{Equation 38) } E_{engine,TOTAL} = (F_{rich} E_{engine,rich} + F_{lean} E_{engine,lean}) \times W_{gas} \times \frac{1}{N_{lateral}}$$

where:

$E_{engine,TOTAL}$  is the total emissions from lateral compressor engines in a county [ton/yr]  
 $F_{rich}$  is the fraction of rich-burn lateral compressors in the county amongst all lateral compressors  
 $E_{engine,rich}$  is the total emissions from a single rich burn compressor engine per Equation (37) [ton/yr]  
 $F_{lean}$  is the fraction of lean-burn lateral compressors in the county amongst all lateral compressors  
 $E_{engine,lean}$  is the total emissions from a single lean burn compressor engine per Equation (37) [ton/yr]  
 $W_{gas}$  is the total gas well count in a county  
 $N_{lateral}$  is the number of gas wells served by a lateral compressor engine

### Example Calculation for Rich-Burn Lateral Compressor:

Using the equations provided above, NO<sub>x</sub> emissions from rich-burn lateral compressor engines in Cleburne County, Arkansas were calculated as follows:

$$E_{engine,rich} = \frac{EF \times HP \times LF \times t_{annual}}{907,185} \times (1 - F_{controlled} \times CF)$$

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where:

$E_{engine, rich}$  = emissions from a rich-burn lateral compressor engine [ton/yr/engine]

$EF = 8.24$  [g/hp-hr]

$HP = 97.0$  [hp]

$LF = 0.74$  (load factor for the engine)

$t_{annual} = 8,760$  [hr/yr]

$F_{controlled} = 0.44$  (fraction controlled)

$CF = 0.90$  (control factor)

907,185 [g/ton]

Therefore:

$$E_{engine, rich} = \frac{8.24 \times 97.0 \times 0.74 \times 8,760}{907,185} \times (1 - 0.44 \times 0.90)$$

$$E_{engine, rich} = 3.45 \text{ [ton/yr/engine]}$$

Total NO<sub>x</sub> emissions from all rich-burn lateral compressor engines in Cleburne County can be evaluated as follows:

$$E_{engine, rich, TOTAL} = (F_{rich} \times E_{engine, rich}) \times W_{gas} \times \frac{1}{N_{lateral}}$$

where:

$E_{engine, rich, TOTAL}$  = total emissions from rich-burn lateral compressor engines in a county [ton/yr]

$F_{rich} = 0.490$  (fraction of rich burn engines)

$E_{engine, rich} = 3.45$  [ton/yr/engine]

$W_{gas} = 490$  [wells]

$N_{lateral} = 32.05$  (number of gas wells served by a lateral compressor engine)

Therefore:

$$E_{engine, rich, TOTAL} = (0.490 \times 3.45) \times 490 \times \frac{1}{32.05}$$

$$E_{engine, rich, TOTAL} = 25.8 \text{ [ton/yr]}$$

### 3.13 Liquids Unloading

This source category refers to emissions from venting gas from gas wells to prevent liquid build-up in the well that could limit production. This practice is also commonly referred as “well blowdowns”. Vented gas from liquids unloading is a VOC emissions source. Some wells use plunger lifts for liquids unloading, which can also result in vented emissions. Liquids unloading emissions may be controlled by a combustion device such as a flare, or may also be

controlled by a variety of devices and practices that reduce venting from the liquids unloading. Figure 3-11 shows 2 wells equipped with plunger lifts.<sup>3</sup>



**Figure 3-11. Plunger Lifts**

Emissions from liquids unloading are based on the average venting volume per liquids unloading and the gas composition of the vented gas. The calculation methodology for estimating emissions from a single liquids unloading event is shown below in Equation 39:

$$\text{Equation 39)} \quad E_{\text{liquids unloading},i} = \left( \frac{P \times (V_{\text{vented}})}{\left( \frac{R}{MW_{\text{gas}}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f_i}{907,185}$$

where:

$E_{\text{liquids unloading},i}$  is the emissions of pollutant  $i$  from a single liquids unloading event [ton/event]

$P$  is atmospheric pressure [1 atm]

$V_{\text{vented}}$  is the volume of vented gas per liquids unloading [MCF/event]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{\text{gas}}$  is the molecular weight of the gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_i$  is the mass fraction of pollutant  $i$  in the vented gas

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<sup>3</sup> Artificial Lift R&D Council, 2014. Internet address: <http://www.alrdc.org/production/>

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$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

#### **Emissions from flare controls for liquids unloading vents**

In areas where flaring is used to control liquids unloading vents, the methodology for estimating flaring emissions is described below:

Equation 40)

$$E_{flare, liquids unloading} = \left( \frac{EF_i \times V_{vented} \times F \times (C_{captured}) \times (C_{efficiency}) \times HV}{1,000} \times W_{gas} \times N_{blowdown} \right) / 2,000$$

where:

$E_{flare, liquids unloading}$  is the county-wide flaring emissions of pollutant  $i$  for liquids unloading [ton/yr]

$EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]

$V_{vented}$  is the volume of vented gas per liquids unloading [MCF/event]

$F$  is the fraction of well liquids unloading that are flared

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$HV$  is the local heating value of the gas [BTU/SCF]

$W_{gas}$  is the county-wide number of active gas wells for a particular year [wells]

$N_{blowdown}$  the number of annual blowdowns per well in the county [event/yr-well]

1,000 is the unit conversion factor MCF/MMCF

2,000 is the unit conversion factor lb/ton

The methodology for estimating SO<sub>2</sub> emissions from flaring of liquids unloading gas is shown below:

Equation 41)

$$E_{flare, liquids unloading, SO_2} = \left( \frac{P \times (V_{vented} \times W_{gas} \times N_{blowdown}) \times F \times (C_{captured}) \times (C_{efficiency})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times f_{H_2S} \times \frac{2}{907,185}$$

where:

$E_{flare, liquids unloading, SO_2}$  is the county-wide SO<sub>2</sub> flaring emissions from flaring of liquids unloading vent gas [ton/yr]

$P$  is atmospheric pressure [1 atm]

$V_{vented}$  is the volume of vented gas per liquids unloading [MCF/event]

$W_{gas}$  is the county-wide number of gas wells [wells]

$N_{blowdown}$  the number of annual blowdowns per well in the county [event/yr-well]

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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$F$  is the fraction of liquids unloading with flares

$C_{\text{captured}}$  is the capture efficiency of the flare

$C_{\text{efficiency}}$  is the control efficiency of the flare

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{\text{gas}}$  is the molecular weight of the liquids unloading gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{\text{H}_2\text{S}}$  is the mass fraction of H<sub>2</sub>S in the liquids unloading venting gas

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

The U.S. Inventory of Greenhouse Gas Emissions and Sinks (U.S. GHG Inventory) was updated in 2014 to reflect newly available data on emissions from liquids unloading.<sup>4</sup> Specifically, EPA analyzed a report issued in September of 2012 by the American Petroleum Institute (API) and America's Natural Gas Alliance (ANGA) entitled "Characterizing Pivotal Sources of Methane Emissions from Natural Gas Production". Using data presented in the report, EPA developed updated vent rates ( $V_{\text{vented}}$  in Equation 40) for liquids unloading activities based on U.S. EIA Supply Regions. Figure 3-12 below shows the six EIA Supply Regions used in the U.S. GHG Inventory.

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<sup>4</sup> U.S. EPA, 2013. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013. Internet address: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>

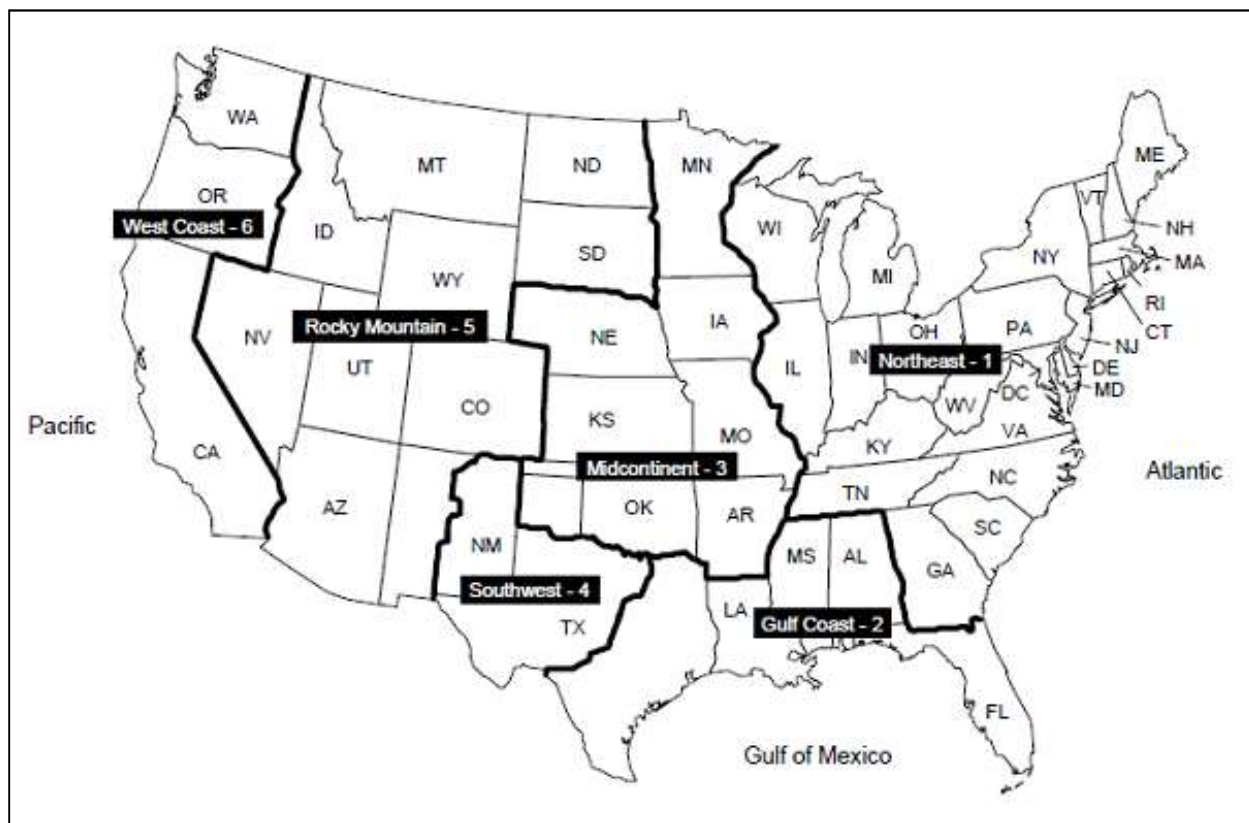


Figure 3-12. EIA Supply Region Map

Table 3-2 below shows the vent rates ( $V_{vented}$  in Equation 40) by EIA Supply Region for each venting scenario used in the U.S. GHG Inventory.

Table 3-2. Liquids Unloading Vent Rates from the U.S. GHG Inventory

EIA Supply Region	Wells venting with plunger lift (%)	Wells venting without plunger lift (%)	Vent Rate for Wells with Plunger Lift (scf/yr/well) <sup>a</sup>	Vent Rate for Wells without Plunger Lift (scf/yr/well) <sup>a</sup>
North East	4.3	11.26	314,626	166,174
Midcontinent	2.33	4.14	1,379,958	230,199
Rocky Mountain	12.88	1.52	154,300	2,579,444
South West	3.32	19.47	3,547	96,748
West Coast	7.59	6.80	345,343	304,048
Gulf Coast	2.32	7.08	70,021	300,592

<sup>a</sup> Whole gas vent rates.

### **Nonpoint Oil and Gas Emissions Estimation Tool**

In order to utilize this information within the structure and methodology used in the tool, a weighted vent rate was developed for all wells in a county. Calculation of a weighted vent rate was accomplished using the data in Table 3-2. For example, the updated default liquids unloading vent rate for the North East EIA Supply Region is calculated as follows (using the 2011 value of 153,773 wells in the North East as shown in Table 3-3):

$$E_{liquids\_unloading} = 32,421 \text{ (scf/yr/well)}$$

Table 3-3 shows the resultant default vent rates used in the tool (data from the West Coast Region has been used for the State of Alaska). As these are annual vent rates, where this information is used in the tool, the frequency of liquids unloading venting has been set equal to one event per year. Additionally, as these rates reflect some level of control (through the use of plunger lifts), where this information is used in the tool, a value of “NA” is used for the control method, and no additional reduction from use of controls has been applied.

**Table 3-3. Default Liquids Unloading Vent Rates for the Tool**

<b>EIA Supply Region</b>	<b>Gas Well Count</b>	<b>Default Vent Rate for all Wells (scf/yr/well)</b>
North East	153,773	32,421
Midcontinent	87,193	41,659
Rocky Mountain	58,285	59,047
South West	41,919	18,956
West Coast	1,516	46,884
Gulf Coast	71,629	22,913

#### **Extrapolation to county-level emissions**

The total county-level emissions from all liquids unloading are evaluated following Equation 42:

$$\text{Equation 42)} \quad E_{liquidsunbading,TOTAL} = E_{liquidsunbading,i} \times N_{blowdowns} \times W_{gas} \times (1 - F_{control,device} \times C_{efficiency})$$

where:

$E_{liquids\ unloading,TOTAL}$  are the total county-wide emissions of pollutant i from liquids unloading [tons/yr]

$E_{liquids\ unloading,i}$  are the liquids unloading emissions from a single liquids unloading event [tons/event]

$N_{blowdowns}$  is the number of annual blowdowns per well in the county [event/yr-well]

$W_{gas}$  is the total number of active gas wells in the county for a particular year [well]

$F_{control,device}$  is the fraction of liquids unloading in the county that were controlled

$C_{efficiency}$  is the control efficiency of the control technology used (plunger lifts for example)

## **Nonpoint Oil and Gas Emissions Estimation Tool**

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### **Example Calculation for Liquids Unloading:**

Using the equations provided above, VOC emissions from liquids unloading in Cleburne County, Arkansas were calculated as follows:

$$E_{liquidsunbading} = \left( \frac{P \times (V_{vented})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f}{907,185}$$

where:

$E_{liquidsunloading}$  = emissions from a single liquids unloading event [ton/event]

$P = 1$  [atm]

$V_{vented} = 5.9375$  [MSCF/event]

$R = 0.082$  [L-atm/mol-K]

$MW_{gas} = 17.3066$  [g gas/mole gas]

$T = 298$  [K]

$f = 0.03429$  [VOC fraction]

$3.5 \times 10^{-5}$  [MCF/L]

907,185 [g/ton]

Therefore:

$$E_{liquidsunloading} = \left( \frac{1 \times (5.9375)}{\left( \frac{0.082}{17.3066} \right) \times 298 \times 3.5 \times 10^{-5}} \right) \times \frac{0.03429}{907,185}$$

$$E_{liquidsunloading} = 0.004541 \text{ [ton/event]}$$

In this example, liquids unloading emissions are controlled through the use of a Plunger lift, ESP, or Beam Pump.

Therefore, total VOC emissions from liquids unloading venting in Cleburne County were calculated as follows:

$$E_{liquidsunloadingTOTAL} = E_{liquidsunloading} \times N_{blowdown} \times W_{gas} \times (1 - F_{controldevice} \times C_{efficiency})$$

where:

$E_{liquidsunloading,TOTAL}$  are the total county-wide emissions of VOC from blowdowns [ton/yr]

$E_{liquidsunloading} = 0.004541$  [ton/event]

$N_{blowdown} = 64$  [event/yr-well]

$W_{gas} = 490$  [wells]

$F_{control,device} = 0.3769$  (fraction controlled)

$C_{efficiency} = 0.7063$  (control efficiency expressed as fraction)

Therefore:

$$E_{liquidsunbadingTOTAL} = 0.004541 \times 64 \times 490 \times (1 - 0.3769 \times 0.7063)$$

$$E_{liquidsunloading,TOTAL} = 104.5 \text{ [ton/yr]}$$

Note that if liquids unloading emissions were controlled through the use of flares, flaring emissions would be calculated using equations 40 and 41.

### **3.14 Loading**

This category refers to loading losses that occur when transferring hydrocarbon liquids, crude oil or condensate, from storage tanks to cargo trucks. Figure 3-13 shows truck loading operations at a tank battery in Mississippi.



**Figure 3-13. Truck Loading Operations**

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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The emissions from loading operations will vary by the gas speciation of the working losses; hence emissions were calculated separately for each hydrocarbon liquid. Equations 43-46 may be used for both categories (SCCs). The loading loss rate is estimated following Equation 43:

Equation 43) 
$$L = 12.46 \times \left( \frac{S \times V \times MW_{gas}}{T} \right)$$

where:

$L$  is the loading loss rate [lb/1,000gal]

$S$  is the saturation factor taken from AP-42 default values based on operating mode (here assumed as submerged loading: dedicated normal service)

$V$  is the true vapor pressure of the liquid loaded [psia]

$MW_{gas}$  is the molecular weight of the vapor [lb/lb-mole]

$T$  is the temperature of the bulk liquid [°R]

VOC truck loading emissions are then estimated by Equation 44 which is dependent on the VOC fraction in the gas. When available, county-specific working/breathing gas compositions from condensate/crude oil storage tanks were used in Equations 44-46; however when county-level data was limited or unavailable, produced gas analyses were used to speciate emissions from each pollutant.

Equation 44) 
$$E_{loading, VOC} = \frac{L}{1,000} \times Y_{voc} \times \frac{42}{2,000}$$

where:

$E_{loading, VOC}$  are the VOC tank loading emissions [ton-VOC/bbl]

$L$  is the loading loss rate [lb/1,000gal]

$Y_{VOC}$  is the weight fraction of VOC in the vapor in the liquid loaded

42 is a unit conversion [gal/bbl]

2,000 is a unit conversion [lbs/ton]

Emissions of other pollutants are calculated based on Equation 45:

Equation 45) 
$$E_{loading, i} = E_{loading, VOC} \times \frac{weight\ fraction_i}{weight\ fraction_{VOC}}$$

where:

$E_{loading, i}$  is the total loading emissions of pollutant “i” per barrel of liquid [ton/bbl]

$(weight\ fraction_i / weight\ fraction_{voc})$  is the mass-based weight fraction of pollutant i divided by the weight fraction of VOC in the gas

### **Extrapolation to county-level emissions**

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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Annual emissions per pollutant  $i$  from condensate loading were scaled to county-level by annual condensate production per Equation 46:

$$\text{Equation 46)} \quad E_{\text{tank loadout}, i} = E_{\text{loading}, i} \times P_{\text{condensate}} \times F_{\text{trucked}}$$

where:

$E_{\text{tank loadout}, i}$  is the annual county-level emissions for pollutant  $i$  from condensate tank load-out [ton/yr]

$E_{\text{loading}, i}$  is the emissions for pollutant  $i$  from loading per barrel [ton/bbl]

$P_{\text{condensate}}$  is the total annual of barrels condensate produced county-wide [bbl/yr]

$F_{\text{trucked}}$  is the fraction of condensate production that is delivered by truck

Annual emissions per pollutant  $i$  from oil loading were scaled to county-level by annual oil production per Equation 47:

$$\text{Equation 47)} \quad E_{\text{tank loadout,oil}, i} = E_{\text{loading}, i} \times P_{\text{oil}} \times F_{\text{trucked}}$$

where:

$E_{\text{tank loadout}, i}$  is the annual county-level emissions for pollutant  $i$  from crude oil tank load-out [ton/yr]

$E_{\text{loading}, i}$  is the emissions for pollutant  $i$  from loading per barrel [ton/bbl]

$P_{\text{oil}}$  is the total annual county-wide oil production [bbl/yr]

$F_{\text{trucked}}$  is the fraction of oil production that is delivered by truck

#### **Example Calculation for Loading:**

Using the equations provided above, VOC emissions for condensate loading in Columbia County, Arkansas were calculated as follows:

$$L = 12.46 \times \left( \frac{S \times V \times MW_{\text{gas}}}{T} \right)$$

where:

$L$  is the loading loss rate [lb/1,000gal]

$S = 0.6$  (based on submerged loading: dedicated normal service)

$V = 5.12$  [psia]

$MW_{\text{gas}} = 54.2$  [lb/lb-mole]

$T = 540$  [°R]

Therefore:

$$L = 12.46 \times \left( \frac{0.6 \times 5.12 \times 54.2}{540} \right)$$

$$L = 3.84 \text{ [lb/1,000gal]}$$

Total VOC emissions from all condensate loading in Columbia County can be evaluated as follows:

$$E_{loading,VOC} = \frac{L}{1,000} \times Y_{voc} \times \frac{42}{2,000}$$

where:

$E_{loading,VOC}$  are the VOC tank loading emissions [ton-VOC/bbl]

$L = 3.84$  [lb/1,000gal]

$Y_{VOC} = 0.933$

42 [gal/bbl]

2,000 [lb/ton]

Therefore:

$$E_{loading} = \frac{3.84}{1,000} \times 0.933 \times \frac{42}{2,000}$$

$$E_{loading} = 0.0000752 \text{ [ton-VOC/bbl]}$$

Annual emissions of VOC from condensate loading are then scaled to the county-level using:

$$E_{tank \text{ loadout}} = E_{loading,VOC} \times P_{condensate} \times F_{trucked}$$

where:

$E_{tank \text{ loadout}}$  is the annual county-level emissions of VOC from condensate tank load-out [ton/yr]

$E_{loading,VOC} = 0.0000752$  [ton-VOC/bbl]

$P_{condensate} = 275,892$  [bbl/yr]

$F_{trucked} = 1$

Therefore:

$$E_{tank \text{ loadout}} = 0.0000752 \times 275,892 \times 1$$

$$E_{tank \text{ loadout}} = 20.76 \text{ [ton/yr]}$$

### 3.15 Mud Degassing

Drilling mud degassing refers to the practice of extracting the entrained gas from the drilling mud once it is outside of the wellbore. During this process VOCs and CH<sub>4</sub> (and other pollutants in the gas) are vented to the atmosphere. National default emissions factors for mud degassing are available from The Climate Registry Reporting Protocol as shown in Table 3-4:

**Table 3-4. National Default Emissions Factors for Mud Degassing by Mud Base**

Emission Source	Emission Factor Units <sup>5</sup>	Emission Factor Units <sup>6</sup>
Mud degassing – water-based mud	881.84 lbs THC / drilling day	0.2605 tonnes CH <sub>4</sub> / drilling day
Mud degassing – oil-based mud	198.41 lbs THC / drilling day	0.0586 tonnes CH <sub>4</sub> / drilling day
Mud degassing – synthetic mud	198.41 lbs THC / drilling day	0.0586 tonnes CH <sub>4</sub> / drilling day

Water-based mud emissions factors were assumed as a default conservative value, but this parameter may be updated in the tool. To account for the use of different mud bases within a region, the CH<sub>4</sub> emissions factor may be estimated as a weighted average based on a usage fraction of each mud type within a county.

Applying the local-gas CH<sub>4</sub> mass fraction to the mud degassing emission factors provides the site-representative emissions as shown in Equation 48. Because the mud entrained gas is the gas coming out directly from the wellbore during drilling, produced gas compositions by well type are used to characterize these emissions. Equations 48-49 are applicable to both oil and gas wells mud degassing emissions, however gas compositions and surrogate values (spuds) will vary for each well type.

Equation 48) 
$$E_{mudgas,CH_4} = N_{drill} \times EF_{mud,CH_4} \times 1.102 \times \frac{M_{CH_4}}{0.8385}$$

where:

- $E_{mudgas,CH_4}$  is the mud degassing emissions for CH<sub>4</sub> per spud [ton/spud]
- $N_{drill}$  is the number of drilling days per spud [drilling days/spud]
- $EF_{mud,CH_4}$  is the emissions factor for CH<sub>4</sub> [tonne CH<sub>4</sub>/drilling days]
- 0.8385 is the mole percent of CH<sub>4</sub> from the vented gas used to derive the emissions factor (EF)
- $M_{CH_4}$  is the mole percent of CH<sub>4</sub> in the local gas vented during mud degassing [percent, expressed as a fraction] (if county-specific CH<sub>4</sub> emissions factor is used, M=0.8385)
- 1.102 is the conversion of tonnes to short tons

To estimate emissions from other pollutants in the vented gas Equation 49 may be used:

<sup>5</sup> Wilson, Darcy, Richard Billings, Regi Oommen, and Roger Chang, Eastern Research Group, Inc. Year 2005 Gulfwide Emission Inventory Study, U.S. Department of the Interior, Minerals Management Services, Gulf of Mexico OCS Region, New Orleans, December 2007, Section 5.2.10.

<sup>6</sup> Based on gas content of 65.13 weight percent CH<sub>4</sub>, derived from sample data provided in the original source of the emission factors. Original sample data is as follows, in terms of mole%: 83.85% CH<sub>4</sub>, 5.41% C<sub>2</sub>H<sub>6</sub>, 6.12% C<sub>3</sub>H<sub>8</sub>, 3.21% C<sub>4</sub>H<sub>10</sub>, and 1.40% C<sub>5</sub>H<sub>12</sub> (Wilson et al., 2007)

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Equation 49) 
$$E_{mudgas,i} = E_{mudgas,CH_4} \times \frac{MW_i}{MW_{CH_4}} \times \frac{M_i}{M_{CH_4}}$$

where:

$E_{mudgas,i}$  is the mud degassing emissions for pollutant i per spud [ton/spud]  
 $EF_{mudgas, CH_4}$  is the vented emissions for CH<sub>4</sub> [ton CH<sub>4</sub>/spud]  
 $MW_i$  is the molecular weight of pollutant i [lb/lb-mol]  
 $MW_{CH_4}$  is the molecular weight of CH<sub>4</sub> [lb/lb-mol]  
 $M_{CH_4}$  is the mole percent of CH<sub>4</sub> in the local gas vented during mud degassing [percent, expressed as a fraction]  
 $M_i$  is the mole percent of pollutant in the local gas vented during mud degassing [percent, expressed as a fraction]

#### **Extrapolation to county-level emissions**

To estimate county-wide annual emissions, mud degassing emissions by spud are scaled with the county-wide count of drilling events (spuds), according to Equation 50:

Equation 50) 
$$E_{mudgas,TOTAL\ i} = E_{mudgas, i} \times S_{spuds}$$

where:

$E_{mudgas,TOTAL,i}$  is the annual county-wide emissions for pollutant i from mud degassing [ton/yr]  
 $E_{mudgas, i}$  is the emissions from mud degassing from a drilling event [ton/spud]  
 $S_{spuds}$  is the number of wells drilled in a county for a particular year [spud/yr]

#### **Example Calculation for Mud Degassing:**

Using the equations provided above, VOC emissions for mud degassing in Cleburne County, Arkansas were calculated as follows:

$$E_{mudgas,CH_4} = N_{drill} \times EF_{mudgas,CH_4} \times 1.102 \times \frac{M_{CH_4}}{0.8385}$$

where:

$E_{mudgas, CH_4}$  is the mud degassing emissions for CH<sub>4</sub> per spud [ton/spud]  
 $N_{drill} = 20.22$  [drilling days/spud]  
 $EF_{mudgas, CH_4} = 0.2605$  [tonnes CH<sub>4</sub>/drilling days]  
 $M_{CH_4} = 0.94$  [percent, expressed as a fraction]  
 $0.8385$  = [mole fraction CH<sub>4</sub> used to derive emission factor]  
 $1.102$  [ton/tonnes]

Therefore:

$$E_{mudgas,CH_4} = 20.22 \times 0.2605 \times 1.102 \times \frac{0.94}{0.8385}$$

$$E_{mudgas, CH_4} = 6.51 \text{ [tons CH}_4\text{/well/yr]}$$

VOC emissions are then calculated using:

$$E_{mudgas, VOC} = E_{mudgas, CH_4} \times \frac{MW_{VOC}}{MW_{CH_4}} \times \frac{M_{VOC}}{M_{CH_4}}$$

where:

$E_{mudgas, VOC}$  is the emissions of VOC per completion [ton/completion]

$E_{mudgas, CH_4} = 6.51$  [ton CH<sub>4</sub>/well-yr]

$MW_{VOC} = 52.1$  [lb/lb-mol]

$MW_{CH_4} = 16.04$  [lb/lb-mol]

$M_{CH_4} = 0.94$  [percent CH<sub>4</sub>, expressed as a fraction]

$M_{VOC} = 0.01$  [percent VOC, expressed as a fraction]

Therefore:

$$E_{mudgas, VOC} = 6.51 \times \frac{52.1}{16.04} \times \frac{0.01}{0.94}$$

$$E_{mudgas, VOC} = 0.225 \text{ [ton/well-yr]}$$

Total VOC emissions from all mud degassing in Cleburne County can be evaluated as follows:

$$E_{mudgas, TOTAL} = E_{mudgas, VOC} \times S_{spuds}$$

where:

$E_{mudgas, TOTAL}$  is the annual county-wide VOC emissions from mud degassing [ton/yr]

$E_{mudgas, VOC} = 0.225$  [ton/spud]

$S_{spuds} = 133$  [spud/yr]

Therefore:

$$E_{mudgas, TOTAL} = 0.225 \times 133$$

$$E_{mudgas, TOTAL} = 29.93 \text{ [ton/yr]}$$

### 3.16 Pneumatic Devices

Pneumatic devices are located at the well site and use high-pressure produced gas to produce mechanical motion. These devices are typically under operation throughout the year and they may or may not vent the working fluid during operation, making them a potentially

significant source of VOC emissions. Figure 3-14 shows a pneumatic valve at a well in the Marcellus shale. <sup>1</sup>



**Figure 3-14. Pneumatic Valve**

The counts of pneumatic devices vary between oil and gas wells, thus emissions are estimated separately for both well types. Emissions from pneumatic devices vary by the bleed rate of the device. Here it is assumed that four configurations can be found in a typical well: high bleed, low bleed, intermittent and no bleed. Emissions for the first three types of device  $i$  must be estimated. The methodology for estimating the emissions from pneumatic devices for a particular type of well are shown in Equation 51:

$$\text{Equation 51) } E_{pneumatic,j} = \frac{f_j}{907,185} \left( \sum_i \dot{V}_i \times N_i \times t_{annual} \right) \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{pneumatic,j}$  is the total emissions of pollutant  $j$  from all pneumatic devices for a particular type of well (oil vs. gas) [ton/yr/well]

$f_j$  is the mass fraction of pollutant  $j$  in the vented gas (produced gas)

$\dot{V}_i$  is the volumetric bleed rate from device  $i$  [SCF/hr/device]

$N_i$  is the number of devices  $i$  found in a type of well (oil vs. gas) [devices/well]

$t_{annual}$  is the number of hours per year that devices were operating [8760 hr/yr]

$P$  is the atmospheric pressure [1 atm]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the gas [g/mol]

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$T$  is the atmospheric temperature [298 K]  
 $3.5 \times 10^{-5}$  is the unit conversion factor MCF/L  
907,185 is the unit conversion factor g/ton  
1,000 is the unit conversion factor SCF/MCF

### Extrapolation to county-level emissions

County-wide pneumatic device emissions for each well type are estimated according to Equation 52:

$$\text{Equation 52)} \quad E_{pneumatic,TOTAL,j} = E_{pneumatic,j} \times W_{gas\ or\ oil}$$

where:

$E_{pneumatic,TOTAL,j}$  is the total pneumatic device emissions of pollutant  $j$  in the county [ton/yr]  
 $E_{pneumatic,j}$  is the pneumatic device emissions of pollutant  $j$  for a type of well (gas vs. oil) [ton/yr/well]  
 $W_{gas\ or\ oil}$  is the total number of active gas (or oil) wells in the county [wells]

Total emissions from pneumatic devices will be the combination of county-wide emissions from each well type:

$$\text{Equation 53)} \quad E_{allpneumatics,j} = \left[ E_{pneumatic,TOTAL,j} \right]_{gaswells} + \left[ E_{pneumatic,TOTAL,j} \right]_{oilwells}$$

Subpart W of the GHGRP prescribes bleed rates for low bleed, high bleed, and intermittent bleed devices that are to be used by reporters to estimate emissions. These rates, shown in Table 3-5 below, have been incorporated into the tool as default bleed rates for pneumatic devices used at oil and gas wells.

**Table 3-5. Whole Gas Bleed Rates for Pneumatic Devices**

Onshore petroleum and natural gas production	Bleed Rate (scf/hour/component)
Low Bleed Pneumatic Devices	1.39
High Bleed Pneumatic Devices	37.3
Intermittent Bleed Pneumatic Devices	13.5

The U.S. GHG Inventory utilizes per-well pneumatic device counts that are used in the tool. For gas wells, the total device counts in the U.S. GHG Inventory were used to derive default device counts by device type using the distribution between low, intermittent, and high bleed devices found in the CenSARA inventory and survey effort. The updated default device counts are shown in Table 3-6 below for each EIA Supply Region. (Note that for oil wells, the total device counts by device type will be updated in future inventories as EPA has identified a calculation error for the oil well device counts shown in Table 3-6.)

**Table 3-6. Pneumatic Device Counts for Oil and Gas Wells**

EIA Supply Region	Oil Well Device Counts			Gas Well Device Counts		
	Low Bleed	High Bleed	Intermittent Bleed	Low Bleed	High Bleed	Intermittent Bleed
North East	0.495	0.267	0	0.144	0.222	0.120
Midcontinent	0.495	0.267	0	0.460	0.709	0.382
Rocky Mountain	0.495	0.267	0	0.434	0.669	0.360
South West	0.495	0.267	0	0.394	0.607	0.327
West Coast	0.495	0.267	0	0.297	0.458	0.247
Gulf Coast	0.495	0.267	0	0.206	0.318	0.171

Example Calculation for Pneumatic Devices:

Using the equations provided above, VOC emissions from low-bleed pneumatic devices located at gas wells in Cleburne County, Arkansas were calculated as follows:

$$E_{pneumatic,VOC,well} = \frac{f}{907,185} \left( \sum_i \dot{V} \times N \times t_{annual} \right) \times \frac{P}{1,000 \times \left( \left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5} \right)}$$

where:

$E_{pneumatic,VOC,well}$  is the total emissions of VOC from low-bleed pneumatic devices  
[ton/yr/well]

$f = 0.0342$  [VOC fraction]

$\dot{V} = 3.151$  [SCF/hr/device]

$N = 0.99$  [devices/well]

$t_{annual} = 8,760$  [hr/yr]

$P = 1$  [atm]

$R = 0.082$  [L-atm/mol-K]

$MW_{gas} = 17.31$  [g/mol]

$T = 298$  [K]

$3.5 \times 10^{-5}$  [MCF/L]

907,185 [g/ton]

1,000 [SCF/MCF]

Therefore:

$$E_{pneumatic,VOC,well} = \frac{0.0342}{907,185} (3.151 \times 0.99 \times 8,760) \times \frac{1}{1,000 \times \left( \left( \frac{0.082}{17.31} \right) \times 298 \times 3.5 \times 10^{-5} \right)}$$

$$E_{pneumatic,VOC,well} = 0.021 \text{ [ton/yr/well]}$$

VOC emissions from low-bleed pneumatic devices located at gas wells in Cleburne County can be evaluated as follows:

$$E_{pneumatic,VOC,TOTAL} = E_{pneumatic,VOC,well} \times W_{gas}$$

where:

$E_{pneumatic,VOC,TOTAL}$  is the total pneumatic device emissions of VOC from low-bleed pneumatic devices located at gas wells in Cleburne county [ton/yr]

$E_{pneumatic,VOC,well} = 0.021$  [ton/yr/well]

$W_{gas} = 490$  [wells]

Therefore:

$$E_{pneumatic,VOC} = 0.021 \times 490$$

$$E_{pneumatic,VOC} = 10.3 \text{ [ton/yr]}$$

### **3.17 Produced Water Tanks**

Water tank emissions are generated by working and breathing processes from tanks used to store produced water. Figure 3-15 shows produced water tanks in the Barnett Shale.



**Figure 3-15. Produced Water Tanks**

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Because information on oil and gas field handling of produced water is limited, emissions from this source were assumed uncontrolled. The methodology for estimating water tank emissions is shown below separately for gas wells and oil wells as water production and gas compositions for each well-type will differ:

### **Gas well water tanks**

$$\text{Equation 54)} \quad E_{\text{water,gaswells,CH}_4} = \frac{EF_{\text{water,tanks,CH}_4}}{2,000} \times P_{\text{water,gas}} \times F_{\text{tank}}$$

where:

$E_{\text{water,gaswells,CH}_4}$  is the county-wide annual CH<sub>4</sub> emissions from water tanks located at gas wells [tons/yr]

$EF_{\text{water,tanks,CH}_4}$  is the emissions factor for CH<sub>4</sub> from working/breathing losses from water tanks in gas well sites [lb/bbl]

$P_{\text{water,gas}}$  is the county-wide annual water production [bbl/yr] from gas wells

$F_{\text{tank}}$  is the fraction of produced water directed to tanks [%]

2,000 is the unit conversion factor lbs/ton

### **Oil well water tanks**

$$\text{Equation 55)} \quad E_{\text{water,oilwells,CH}_4} = \frac{(EF_{\text{water,LPwells,CH}_4} \times F + EF_{\text{water,RPwells,CH}_4} \times (1 - F))}{2,000} \times F_{\text{tank}} \times P_{\text{water,oil}}$$

where:

$E_{\text{water,oil wells,CH}_4}$  is the county-wide annual CH<sub>4</sub> emissions from water tanks located at oil wells [tons/yr]

$EF_{\text{water,LPwells,CH}_4}$  is the emissions factor for CH<sub>4</sub> from working/breathing losses from water tanks at low pressure oil wells (i.e. wells with artificial lifts) [lb/bbl]

$EF_{\text{water,RPwells,CH}_4}$  is the emissions factor for CH<sub>4</sub> from working/breathing losses from water tanks at regular pressure oil well sites [lb/bbl]

$F$  is the fraction of water production from oil wells with artificial lifts

$F_{\text{tank}}$  is the fraction of produced water directed to tanks [%]

$P_{\text{water,oil}}$  is the annual county-wide water production [bbl/yr] from oil wells

2,000 is the unit conversion factor lbs/ton

To estimate emissions of other pollutants in the losses from water tanks, the following equation may be used:

$$\text{Equation 56)} \quad E_{\text{water,wells},i} = EF_{\text{water,wells,CH}_4} \times \frac{MW_i}{MW_{\text{CH}_4}} \times \frac{M_i}{M_{\text{CH}_4}}$$

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where:

$E_{water,wells,i}$  is the water tank county-wide venting losses of pollutant  $i$  from water tanks at particular well type (oil or gas) [ton/yr]

$EF_{water,wells,CH_4}$  is the water tank emissions for  $CH_4$  for a particular well type [ton  $CH_4$ /yr]

$MW_i$  is the molecular weight of pollutant  $i$  [lb/lb-mol]

$MW_{CH_4}$  is the molecular weight of  $CH_4$  [lb/lb-mol]

$M_{CH_4}$  is the mole percent of  $CH_4$  in the water tanks gas (local produced gas) [%]

$M_i$  is the mole percent of pollutant in the water tanks gas (local produced gas) [%]

### Extrapolation to county-level emissions

County-wide emissions from produced water tanks are estimated directly from equations 55 through 57. The sum of oil wells and gas wells water tank emissions yield total county-wide emissions from water tanks.

### Example Calculation for Produced Water Tanks:

Using the equations provided above, VOC emissions for produced water tanks in Columbia County, Arkansas were calculated as follows:

Venting emissions ( $CH_4$ ) from gas wells:

$$E_{water,gaswell} = \frac{EF_{water,tank}}{2,000} \times P_{water,gas} \times F_{tank}$$

where:

$E_{water,gaswell}$  is the county-wide annual  $CH_4$  emissions from water tanks located at gas wells [ton/yr]

$EF_{water,tank} = 0.11$  [lb  $CH_4$ /bbl]

$P_{water,gas} = 1,234,207$  [bbl/yr]

$F_{tank} = 1$  [%]

2,000 [lb/ton]

Therefore:

$$E_{water,gaswell} = \frac{0.11}{2,000} \times 1,234,207 \times 1$$

$$E_{water,gaswell} = 67.9 \text{ [tons } CH_4/\text{yr]}$$

VOC emissions are then calculated using:

$$E_{water,gaswell,VOC} = E_{water,gaswell} \times \frac{MW_{VOC}}{MW_{CH_4}} \times \frac{M_{VOC}}{M_{CH_4}}$$

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where:

$E_{water,gaswell,VOC}$  is the emissions of VOC from produced water at gas wells [ton/yr]

$EF_{water,gaswell} = 67.9$  [tons CH<sub>4</sub>/yr]

$MW_{VOC} = 59.5$  [lb/lb-mol]

$MW_{CH_4} = 16.04$  [lb/lb-mol]

$M_{CH_4} = 0.89$  [percent CH<sub>4</sub>, expressed as a fraction]

$M_{VOC} = 0.04$  [percent VOC, expressed as a fraction]

Therefore:

$$E_{water,gaswell,VOC} = 67.9 \times \frac{59.5}{16.04} \times \frac{0.04}{0.89}$$

$$E_{water,gaswell,VOC} = 11.32 \text{ [ton/yr]}$$

### 3.18 Well Completions

This category refers to emissions from well completions events, which includes initial completions and recompletions. Data provided in the HPDI database includes a count of annual well completions (combines initial and recompletions), thus county-wide emissions will be a combination of the two. However, well completions characteristics will vary by well type; hence emissions are estimated separately for gas well completions and oil well completions. Additionally, emissions are estimated separately for unconventional and conventional completions.

Figure 3-16 shows temporary storage tanks used to collect flowback fluids at an unconventional well completion in the Barnett Shale. Emissions are generated as gas entrained in the flowback fluid is emitted through open vents at the top of the tanks.



Figure 3-16. Well Completion

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The calculation methodology for estimating emissions from a single, uncontrolled completion event is shown below in Equation 57. Emissions from well completions controlled by flaring or use of green completions are calculated using equations 58 - 60 as described below.

$$\text{Equation 57)} \quad E_{\text{completion},i} = \left( \frac{P \times (Q_{\text{completion}})}{\left( \frac{R}{MW_{\text{gas}}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f_i}{907,185}$$

where:

$E_{\text{completion},i}$  is the uncontrolled emissions of pollutant  $i$  from a single completion event [ton/event]

$P$  is atmospheric pressure [1 atm]

$Q_{\text{completion}}$  is the uncontrolled volume of gas generated per completion [MCF/event]

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{\text{gas}}$  is the molecular weight of the gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_i$  is the mass fraction of pollutant  $i$  in the completion venting gas

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

### Flaring emissions from well completion controls

The methodology for estimating flaring emissions from completion venting processes is described below:

$$\text{Equation 58)} \quad E_{\text{flare,completion}} = \left( \frac{EF_i \times Q_{\text{completion}} \times F \times (C_{\text{captured}}) \times (C_{\text{efficiency}}) \times HV}{1,000} \times WC_{\text{county}} \right) / 2,000$$

where:

$E_{\text{flare,completion}}$  is the county-wide flaring emissions of pollutant  $i$  for well completions [ton/yr]

$EF_i$  is the flaring emissions factor for pollutant  $i$  [lb/MMBtu]

$Q_{\text{completion}}$  is the uncontrolled volume of gas generated per completion [MCF/event]

$F$  is the fraction of well completions with flares

$C_{\text{captured}}$  is the capture efficiency of the flare

$C_{\text{efficiency}}$  is the control efficiency of the flare

$HV$  is the local heating value of the gas [BTU/SCF]

$WC_{\text{county}}$  is the county-wide number of well completion events for a particular year [events/yr]

2,000 is the unit conversion factor lbs/ton

1,000 is the unit conversion factor MCF/MMCF

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The methodology for estimating SO<sub>2</sub> emissions from flaring of completion vent gas is shown below:

Equation 59)

$$E_{flare, completion, SO_2} = \left( \frac{P \times (Q_{completion} \times WC_{county}) \times F \times (C_{captured}) \times (C_{efficiency})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times f_{H_2S} \times \frac{2}{907,185}$$

where:

$E_{flare, completion, SO_2}$  is the county-wide SO<sub>2</sub> flaring emissions from flaring of completion vent gas [ton/yr]

$P$  is atmospheric pressure [1 atm]

$Q_{completion}$  is the uncontrolled volume of gas generated per completion [MCF/event]

$WC_{county}$  is the county-wide number of well completion events for a particular year [events/yr]

$F$  is the fraction of well completions with flares

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

$R$  is the universal gas constant [0.082 L-atm/mol-K]

$MW_{gas}$  is the molecular weight of the completion venting gas [g/mol]

$T$  is the atmospheric temperature [298 K]

$f_{H_2S}$  is the mass fraction of H<sub>2</sub>S in the completion venting gas

$3.5 \times 10^{-5}$  is the unit conversion factor MCF/L

907,185 is the unit conversion factor g/ton

### Extrapolation to county-level emissions

Controlled, county-wide emissions are obtained by scaling-up well completions by well type using the number of completion events by well type by year and accounting for any controls used. This is done by applying Equation 60:

Equation 60)

$$E_{completion, TOTAL} = E_{completion, i} \times WC_{county} \left( (1 - F_{flare} \times (C_{captured}) \times (C_{efficiency}) - F_{green}) \right) + E_{flare, completion, i}$$

where:

$E_{completion, TOTAL}$  are the total emissions county-wide of pollutant  $i$  from well completions [tons/yr]

$E_{completion, i}$  are the completion emissions from a single completion event [tons/event]

$WC_{county}$  is the county-wide total completions events in a particular year [events/yr]

$F_{flare}$  is the fraction of completions in the county controlled by flare

$C_{captured}$  is the capture efficiency of the flare

$C_{efficiency}$  is the control efficiency of the flare

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$F_{green}$  is the fraction of completions in the county that were controlled by green completion techniques

$E_{flare, completion, i}$  is the county-wide flaring emissions from flaring of completion vent gas [ton/yr]

#### Example Calculation for Well Completions:

Using the equations provided above, VOC emissions from venting of controlled (accounting for both flaring and green completions) oil well completions in Columbia County, Arkansas were calculated as follows:

$$E_{completion} = \left( \frac{P \times (Q_{completion})}{\left( \frac{R}{MW_{gas}} \right) \times T \times 3.5 \times 10^{-5}} \right) \times \frac{f}{907,185}$$

where:

$E_{completion}$  is the uncontrolled emissions of VOC from a single completion event [ton/event]

$P = 1$  [atm]

$Q_{completion} = 226$  [MCF/event]

$R = 0.082$  [L-atm/mol-K]

$MW_{gas} = 24.25$  [g/mol]

$T = 298$  [K]

$f = 0.26$  [VOC fraction]

$3.5 \times 10^{-5}$  [MCF/L]

$907,185$  [g/ton]

Therefore:

$$E_{completion} = \left( \frac{1 \times (226)}{\left( \frac{0.082}{24.25} \right) \times 298 \times 3.5 \times 10^{-5}} \right) \times \frac{0.26}{907,185}$$

$$E_{completion} = 1.84 \text{ [ton/event]}$$

Well completion flaring emissions are calculated similarly to the example given above for condensate tanks. In this case,  $E_{flare, completion, VOC} = 0.552$  [ton/yr]

Total VOC emissions from well completion venting and flaring in Columbia County were calculated as follows:

$$E_{completionTOTAL} = E_{completion} \times WC_{county} \left( (1 - F_{flare} \times (C_{captured}) \times (C_{efficiency}) - F_{green}) + E_{flare, completion} \right)$$

where:

$E_{\text{completion},\text{TOTAL}}$  are the total emissions county-wide of VOC from well completions [tons/yr]

$E_{\text{completion}} = 1.84$  [tons/event]

$WC_{\text{county}} = 62$  [events/yr]

$F_{\text{flare}} = 0.833$  (fraction flared)

$C_{\text{captured}} = 0.898$  (capture efficiency expressed as fraction)

$C_{\text{efficiency}} = 0.98$  (control efficiency expressed as fraction)

$F_{\text{green}} = 0.167$  (fraction green completions)

$E_{\text{flare},\text{completion}} = 0.552$  [ton/yr]

Therefore:

$$E_{\text{completion},\text{TOTAL}} = 1.84 \times 62 (1 - 0.833 \times (0.898) \times (0.98) - 0.167) + 0.552$$

$$E_{\text{completion},\text{TOTAL}} = 11.95 \text{ [ton/yr]}$$

### 3.19 Wellhead Compressor Engines

Wellhead compressor engines are generally small natural-gas fired engines located at the well site and used to boost produced gas pressure from downhole pressure to the required pressure for delivery to a transmissions pipeline. The fractional usage of these engines will depend on the basin characteristics; hence for those basins that largely require wellhead compression, this may be a significant nonpoint source of NO<sub>x</sub> emissions. Figure 3-17 shows two wellhead compressor engines in the Barnett shale.



**Figure 3-17. Wellhead Compressor Engines**

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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Compressor engines found at a wellhead were categorized into two main categories in this analysis and thus emissions are estimated for each type of engine and consequently extrapolated to county-wide emissions. These categories of compressors are:

- Rich burn compressors
- Lean burn compressors

The basic methodology for estimating emissions from wellhead compressor engines is shown in Equation 61:

$$\text{Equation 61)} \quad E_{\text{engine, type}} = \frac{EF_i \times HP \times LF \times t_{\text{annual}}}{907,185} \times (1 - F_{\text{controlled}} \times CF_i)$$

where:

$E_{\text{engine, type}}$  are emissions from a particular type (rich vs. lean) of compressor engine [ton/yr/engine]  
 $EF_i$  is the emissions factor of pollutant  $i$  [g/hp-hr] (note that this may be different for NO<sub>x</sub> emissions from rich-burn vs. lean-burn engines)  
 $HP$  is the horsepower of the engine [hp]  
 $LF$  is the load factor of the engine  
 $t_{\text{annual}}$  is the annual number of hours the engine is used [hr/yr]  
 $F_{\text{controlled}}$  is the fraction of compressors of a particular type (rich vs. lean) that are controlled  
 $CF_i$  is the control factor for controlled engines for pollutant  $i$   
907,185 is the unit conversion factor g/ton

### **Extrapolation to county-level emissions**

County-level emissions are made up of the combination of emissions from each type of wellhead compressor, rich burn and lean burn. Emissions are scaled to county level using the usage fraction ( $F$ ) of each engine type against all other compressor engines, the fraction of wells with wellhead compressor engines, and the total gas well count in a county, according to equation below:

$$\text{Equation 62)} \quad E_{\text{engine, TOTAL}} = (F_{\text{rich}} E_{\text{engine, rich}} + F_{\text{lean}} E_{\text{engine, lean}}) \times W_{\text{gas}} \times f_{\text{wellhead}}$$

where:

$E_{\text{engine, TOTAL}}$  is the total emissions from wellhead compressor engines in a county [ton/yr]  
 $F_{\text{rich}}$  is the fraction of rich-burn wellhead compressors in the county amongst all wellhead compressors  
 $E_{\text{engine, rich}}$  is the total emissions from a single rich burn compressor engine per Equation (61) [ton/yr]  
 $F_{\text{lean}}$  is the fraction of lean-burn wellhead compressors in the county amongst all wellhead compressors

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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$E_{engine,lean}$  is the total emissions from a single lean burn compressor engine per Equation (61) [ton/yr]

$W_{gas}$  is the total gas well count in a county

$f_{wellhead}$  is the fraction of all gas wells in the county with wellhead compressor engines

#### **Example Calculation for Rich-Burn Wellhead Compressor:**

Using the equations provided above, NO<sub>x</sub> emissions from rich-burn wellhead compressor engines in Cleburne County, Arkansas were calculated as follows:

$$E_{engine,rich} = \frac{EF \times HP \times LF \times t_{annual}}{907,185} \times (1 - F_{controlled} \times CF)$$

where:

$E_{engine,rich}$  = emissions from a rich-burn wellhead compressor engine [ton/yr/engine]

$EF = 8.24$  [g/hp-hr]

$HP = 105.5$  [hp]

$LF = 0.77$  (load factor for the engine)

$t_{annual} = 8,370$  [hr/yr]

$F_{controlled} = 0.44$  (fraction of engines controlled)

$CF = 0.90$  (control factor)

907,185 [g/ton]

Therefore:

$$E_{engine,rich} = \frac{8.24 \times 105.5 \times 0.77 \times 8,370}{907,185} \times (1 - 0.44 \times 0.90)$$

$$E_{engine,rich} = 3.73 \text{ [ton/yr/engine]}$$

Total NO<sub>x</sub> emissions from all rich-burn wellhead compressor engines in Cleburne County can be evaluated as follows:

$$E_{engine,rich,TOTAL} = (F_{rich} \times E_{engine,rich}) \times W_{gas} \times f_{wellhead}$$

where:

$E_{engine,rich,TOTAL}$  = total emissions from rich-burn compressor engines in a county [ton/yr]

$F_{rich} = 0.490$  (fraction of rich burn engines)

$E_{engine,rich} = 3.73$  [ton/yr/engine]

$W_{gas} = 490$  [wells]

$f_{wellhead} = 0.0845$  (fraction of gas wells with compressor engines)

Therefore:

$$E_{engine,rich,TOTAL} = (0.490 \times 3.73) \times 490 \times 0.0845$$

$$E_{engine,rich,TOTAL} = 75.7 \text{ [tons/NO}_x\text{/yr]}$$

#### 4.0 TOOL NONPOINT OIL AND GAS EMISSIONS SUMMARY

Table 4-1 presents a summary of nonpoint oil and gas emissions generated by the tool by state for 2017, including the District of Columbia, Puerto Rico, and the Virgin Islands.

**Table 4-1. State-wide Tool Emissions Estimates**

State	NO <sub>x</sub> (TPY)	VOCs (TPY)	CO (TPY)	Total HAP (TPY)
Alabama	4,356	11,786	6,135	485
Alaska	2,089	22,953	2,963	10,862
Arizona	9	47	12	1
Arkansas	7,230	8,937	6,751	526
California	20,720	40,614	31,807	2,286
Colorado	30,698	67,180	36,605	11,180
Florida	17	657	28	19
Idaho	9	177	15	15
Illinois	23,133	112,866	35,166	477
Indiana	4,139	15,084	5,927	140
Kansas	51,705	94,935	76,626	2,593
Kentucky	12,973	37,060	18,921	1,018
Louisiana	19,207	51,998	26,619	4,647
Maryland	0	1	1	0
Michigan	9,350	16,694	13,325	687
Mississippi	1,733	8,762	2,469	259
Missouri	539	1,214	828	12
Montana	2,455	25,909	3,715	1,083
Nebraska	356	2,294	513	13
Nevada	2	130	4	1
New Mexico	38,092	141,033	53,223	2,630
New York	601	5,394	860	101
North Dakota	17,825	251,419	26,652	9,333
Ohio	2,785	18,629	1,723	344
Oklahoma	43,299	135,661	46,782	5,393
Oregon	14	26	18	3
Pennsylvania	36,603	149,756	51,608	19,890
South Dakota	111	1,308	193	54
Tennessee	835	2,788	1,233	45
Texas	175,772	775,221	224,347	21,219
Utah	8,216	56,550	12,434	1,785
Virginia	3,485	8,569	4,945	539
West Virginia	19,899	70,164	28,501	6,148
Wyoming	17,663	89,680	26,307	3,396

**Table 4-1. State-wide Tool Emissions Estimates**

State	NO <sub>x</sub> (TPY)	VOCs (TPY)	CO (TPY)	Total HAP (TPY)
<b>Total</b>	<b>555,923</b>	<b>2,225,497</b>	<b>747,257</b>	<b>107,184</b>

While there is some variability in emissions due to regional and basin-specific factors such as the VOC weight percent in natural gas, in general, the relative magnitude of state-wide emissions is dependent on the level of oil and gas activity in each state. As shown in Table 4-1, the highest emissions occur in those states with the highest oil and gas production.

Table 4-2 presents a summary of national emissions for 2017 for each source category as calculated by the tool.

**Table 4-2. Source Category Tool Emissions Estimates**

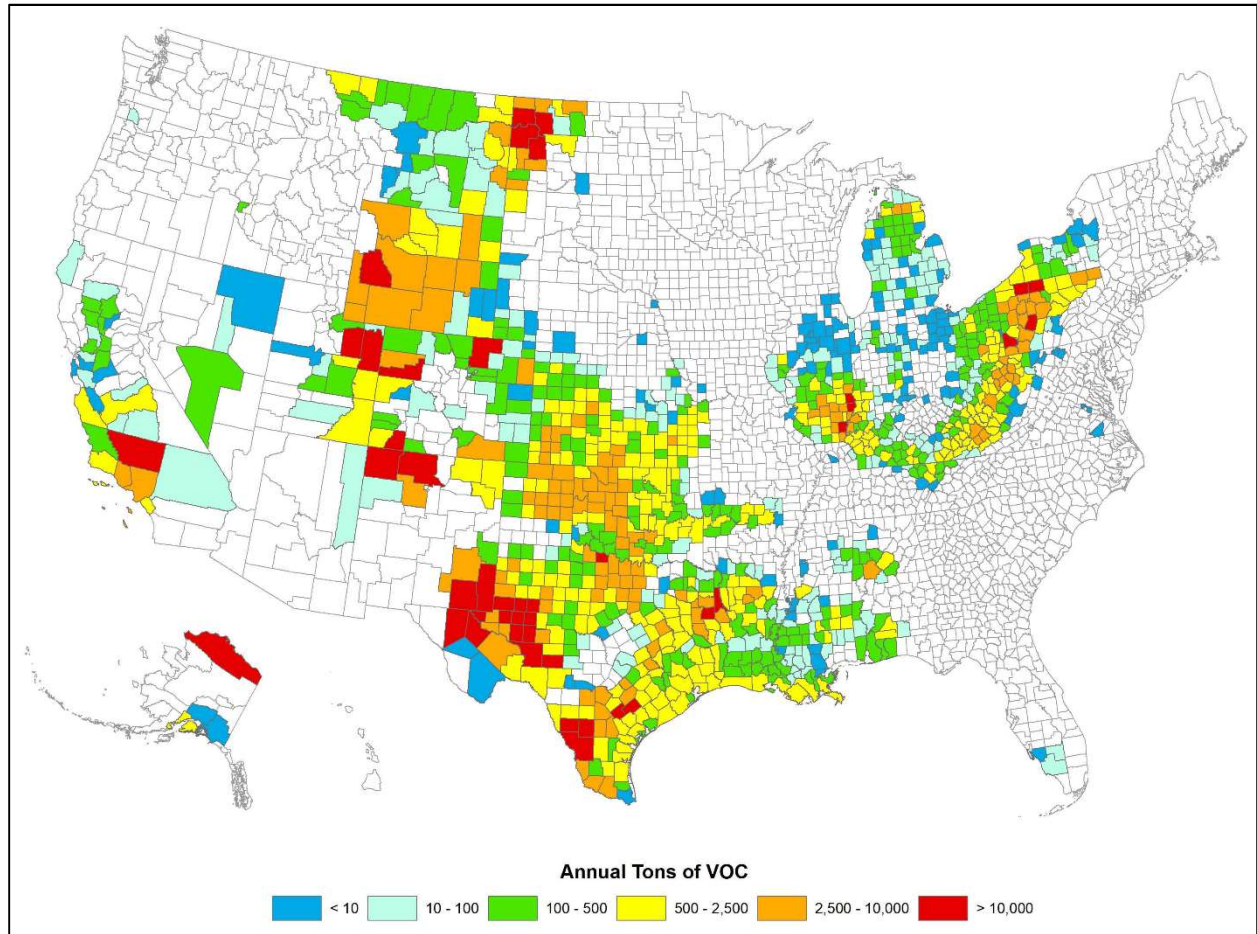
Source Category	NO <sub>x</sub> (TPY)	VOCs (TPY)	CO (TPY)	Total HAP (TPY)
Artificial Lifts	146,629	1,912	226,726	2,094
Associated Gas	571	94,982	3,020	1,125
CBM Dewatering Pump Engines	0	0	0	0
Condensate Tanks	2,103	171,570	11,118	4,302
Crude Oil Tanks	3,000	446,109	15,857	13,325
Dehydrators	560	97,486	928	62,715
Drill Rigs	49,150	3,610	10,504	1,587
Fugitives	0	272,111	0	1,366
Gas-Actuated Pumps	0	176,432	0	1,390
Heaters	32,611	3,082	47,068	1,073
Hydraulic Fracturing	14,167	1,005	2,759	4,470
Lateral/Gathering Compressor Engines	123,480	3,695	174,596	3,062
Liquids Unloading	100	99,301	530	449
Loading Emissions	0	24,395	0	670
Mud Degassing	0	40,809	0	85
Pneumatic Devices	0	637,688	0	2,618
Produced Water	0	59,958	0	240
Well Completions	890	84,959	4,706	1,519
Wellhead Compressor Engines	182,660	6,394	249,446	5,092
<b>Total</b>	<b>555,923</b>	<b>2,225,497</b>	<b>747,257</b>	<b>107,184</b>

As Table 4-2 illustrates, NO<sub>x</sub> emissions are largely dominated by wellhead compressor emissions. This is particularly true for states with a large number of active gas wells. Other significant sources of NO<sub>x</sub> include lateral compressors, well-site heaters, and artificial lift engines. Pneumatic devices and crude oil storage tanks are the most significant source of VOC

### **Nonpoint Oil and Gas Emissions Estimation Tool**

emissions in many states. Other key sources of VOC emission include condensate tanks, dehydrators, and fugitives (equipment leaks).

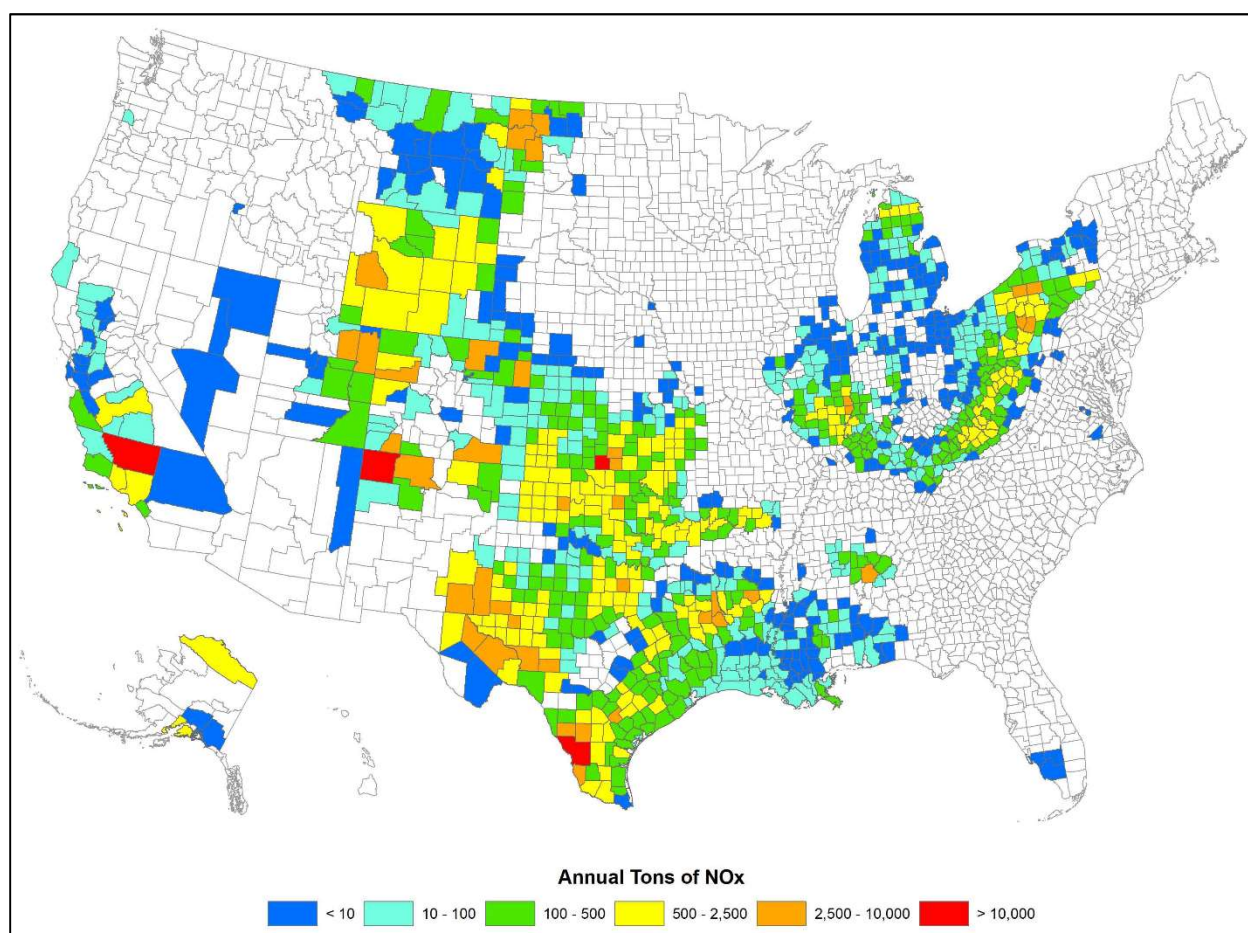
Figure 4-1 below shows 2017 tool nonpoint oil and gas VOC emissions for each county.



**Figure 4-1. Tool Nonpoint Oil and Gas VOC Emissions**

### **Nonpoint Oil and Gas Emissions Estimation Tool**

Figure 4-2 below shows 2017 tool nonpoint oil and gas NO<sub>x</sub> emissions for each county.



**Figure 4-2. Tool Nonpoint Oil and Gas NO<sub>x</sub> Emissions**

## **5.0 NEI NONPOINT OIL AND GAS EMISSIONS SUMMARY**

To develop emissions estimates for the nonpoint oil and gas sector in the 2017 NEI, some states relied on the tool described in detail in this report. While there is much overlap between the NEI and the tool, it is worth emphasizing again that *the tool is not the oil and gas sector NEI*. For many states, the nonpoint oil and gas sector data submitted for inclusion in the NEI are exactly the same (or very close to the same) as the data generated by the tool. This is true for states like Oklahoma that participated in the CenSARA study and which provided corrections and additional input during the development of the tool and which used the tool to generate the data that were submitted to the NEI. This is also the case for states like North Dakota that accepted the NEI emissions data for this sector that were generated by EPA using the tool. In other cases, (e.g., Texas), states have collected data from oil and gas operators directly and have supplemented that data with data from the tool as needed. And still other states (e.g., Pennsylvania) have used the tool in an iterative fashion, generating separate sets of emissions using specific emission factors, activity values, and input parameters selected to reflect a variety of source categories (e.g., coal-bed methane wells, conventional gas wells, unconventional wells) and summed the results (on a county-by-county basis) to yield a more accurate representation of emissions from this sector in their states. In short, the tool has been used to inform the NEI, but the parameters incorporated into the tool (and the emissions generated by the tool) may or may not be the same as the data incorporated into the NEI.

## **6.0 RECOMMENDED IMPROVEMENT ACTIVITIES FOR FUTURE NONPOINT OIL AND GAS EMISSION INVENTORIES**

The nonpoint oil and gas emissions estimation tool developed under this effort provides EPA with default emission estimates for each oil and gas producing county in the country. As mentioned above, these estimates have been used by EPA to gapfill the NEI when state-supplied data is unavailable. Currently, emission estimates in the tool are based on process characterization data and emission factors developed by CenSARA, EPA, the WRAP, and numerous state and local air quality agencies. As available, the data included in the tool is resolved spatially down to the county level to provide a greater geographic specificity. For some areas of the country, region specific information was not available and the tool has been populated for these areas using default data from the CenSARA inventory or from EPA. It is expected that these areas have their own unique characteristics that are not reflected in the data currently used in the tool.

Many states, intergovernmental agencies, and other groups have developed their own oil and gas nonpoint emission inventories using localized data such as air permitting records and drilling permits and authorizations and have submitted these inventories to EPA for inclusion in the NEI. Additionally, EPA anticipates that substantial amounts of new information on the oil and gas sector will become available in the coming years from a variety of ongoing studies being conducted by government, academic, and industry researchers and organizations. For example, the required reporting of GHG emissions and other data by the oil and gas sector under Subpart W of GHGRP continues to expand, and the recent changes to the New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) applicable to this industry have required much more detailed monitoring and recordkeeping than this industry was subject to even three or four years ago. As such, EPA continues to review information and data from these sources as they become available for potential incorporation into the tool.

Given the above, the following recommended improvements are presented for consideration for future development and refinement of the tool:

- **Continued coordination between EPA, states, and intergovernmental agencies to exchange and share information from their oil and gas nonpoint source inventory programs.** Many states have compiled nonpoint emission estimates and methodologies for oil and gas sources. For example, TCEQ's oil and gas inventory served as the starting point for development of the CenSARA inventory, which was then developed further into the tool; Pennsylvania has developed a specific emissions inventory for unconventional exploration and production; and Wyoming inventories individual oil and gas well pads. A free and open exchange of data, including mechanisms to make such data sharing easy for all users, would be beneficial to all parties. This is especially important for states that have relied on their own data with or without supplementing that data with data from the tool. In addition, it would be helpful to compare inventories compiled by states to what is generated by the tool, especially in cases where the state estimates and the tool estimates differ

dramatically. This comparison would help facilitate much-needed quality control analysis. This is especially important where emission methodologies differ as, for example, where states rely on individual company submissions for each individual wellhead site and the tool relies on county-level activity factors and process characterization data. The National Oil & Gas Emissions Committee has created an information repository to facilitate such information transfer (<http://vibe.cira.colostate.edu/OGEC/>).

- **Conduct data collection surveys in areas not under the CenSARA domain.** In addition to reaching out to interested states and intergovernmental agencies that are currently collecting data or estimating emissions from nonpoint oil and gas sources, additional surveys should be conducted to obtain basin-specific process characterization data for areas of the country that are not currently well characterized in the tool.
- **Add processes, control devices, and source categories.** Additional processes such as saltwater injection, vapor recovery unit engines, turbines, flares (as a separate source type), construction and workover equipment, and other source categories could be added to the tool as suggested by stakeholders.
- **Update emission estimation methodologies to account for electric-powered equipment.** Many wellhead sites, especially those in urban areas with access to electrical power, are being hooked up to the grid to power equipment currently powered by field gas. Including options in the tool to identify the fraction of units powered by electricity would help refine the emission estimates for affected categories.
- **Allow for various levels of granularity.** Consider adding the ability to perform more granular estimates at the sub-basin, field, or formation level or for well type (e.g. conventional and unconventional) or age for states that have those data available, while allowing for a less granular approach where detailed sub-basin data are lacking.
- **Improve the tool reports capability.** The tool could be modified to facilitate generation of additional reports requested by stakeholders, which would aid in data analysis and quality assurance operations.
- **Consider adding a module to evaluate midstream oil and gas emissions.** A number of states collect point-source emissions data from midstream oil and gas companies and submit that data to the NEI. For states that do not collect point-source midstream data, it would be helpful to include nonpoint emissions module for this sector. In addition, the demarcation between the midstream and upstream sectors could be made more clear to determine exactly what the tool currently covers, and what it does not. Alternatively, an entirely separate midstream tool could be developed.

**APPENDIX A – INSTRUCTIONS FOR USING THE EPA NONPOINT OIL AND GAS EMISSIONS  
ESTIMATION TOOL, EXPLORATION MODULE (3/25/2019)**

## **Instructions for Using the 2017 EPA Nonpoint Oil and Gas Emissions Estimation Tool, Exploration Module (3/25/2019)**

### **1.0 Introduction**

Under Work Assignment with U.S. EPA, Eastern Research Group, Inc. (ERG) was tasked to develop a tool that state, local, and tribal (SLT) agencies could use to develop a nonpoint source emission inventory for upstream oil and natural gas activities. To this end, ERG prepared the EPA Nonpoint Oil and Gas Emissions Estimation Tool for the 2011 base year to assist agencies in compiling, allocating, and adjusting upstream oil and natural gas activity data, and developing county-level nonpoint source emission estimates.

In support of the 2014 NEI, U.S. EPA directed ERG to redesign the Tool to enhance the User experience. Such enhancements included, but were not limited to: 1) the development of a “Dashboard View” to guide the User; 2) the creation of data entry forms; 3) the creation of a MS Excel-based data import/export utility; 4) ability to view EPA default data; and 5) more flexibility in how data are presented. As part of this work and to increase the efficiency, the Tool was split into two separate modules (i.e., two separate databases): exploration activities and production activities. These instructions address use of the exploration module.

For the 2017 NEI, U.S. EPA directed ERG to build upon the re-engineered Production and Exploration Tools to reflect 2017 activity, as well as include additional PM species, update county FIPS code changes, and include new source categories and pollutants, when available. The tool generated estimates for 55 source classification codes (SCCs) and 70 pollutants. Where state or local data were not submitted to the NEI, EPA uses the estimates generated for inclusion in the 2017 NEI.

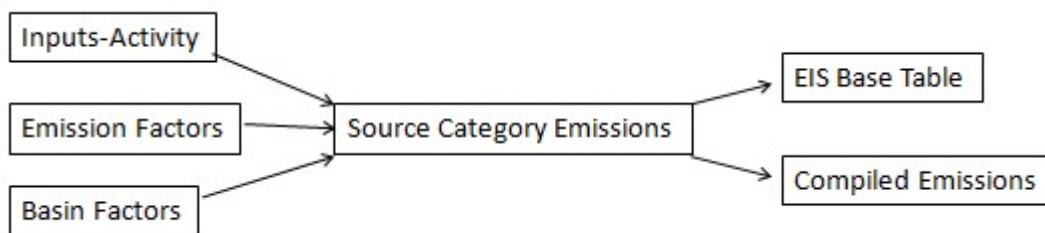
### **2.0 MS-Access Databases**

The Nonpoint Oil and Gas Emissions Estimation Tools were programmed in MS-Access. This platform offered several advantages, particularly in accessibility (software is available to most users), familiarity (MS-Access is used by most SLT agencies in preparation of Emission Inventory System (EIS) data files), and portability (the tool modules can be e-mailed as zipped files that are less than 25 MB each in size).

Included with the tool are the Nonpoint Emissions blank staging tables which are to be used for preparation of EIS data files.

### **3.0 Tool Data Flow**

The basic concept of the tool is to calculate the source category emissions using the activity data, emission factors, and basin factors. A conceptual flow is:



### **4.0 Steps for Using the Oil and Natural Gas Tool for Exploration Sources to Generate Emissions**

In this section, steps will be outlined to generate emissions from the Exploration sources.

### ***Nonpoint Oil and Gas Emissions Estimation Tool***

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Note: If the User will be editing an existing version of the database and wishes to reset the tool and regenerate the emissions, the following steps are recommended:

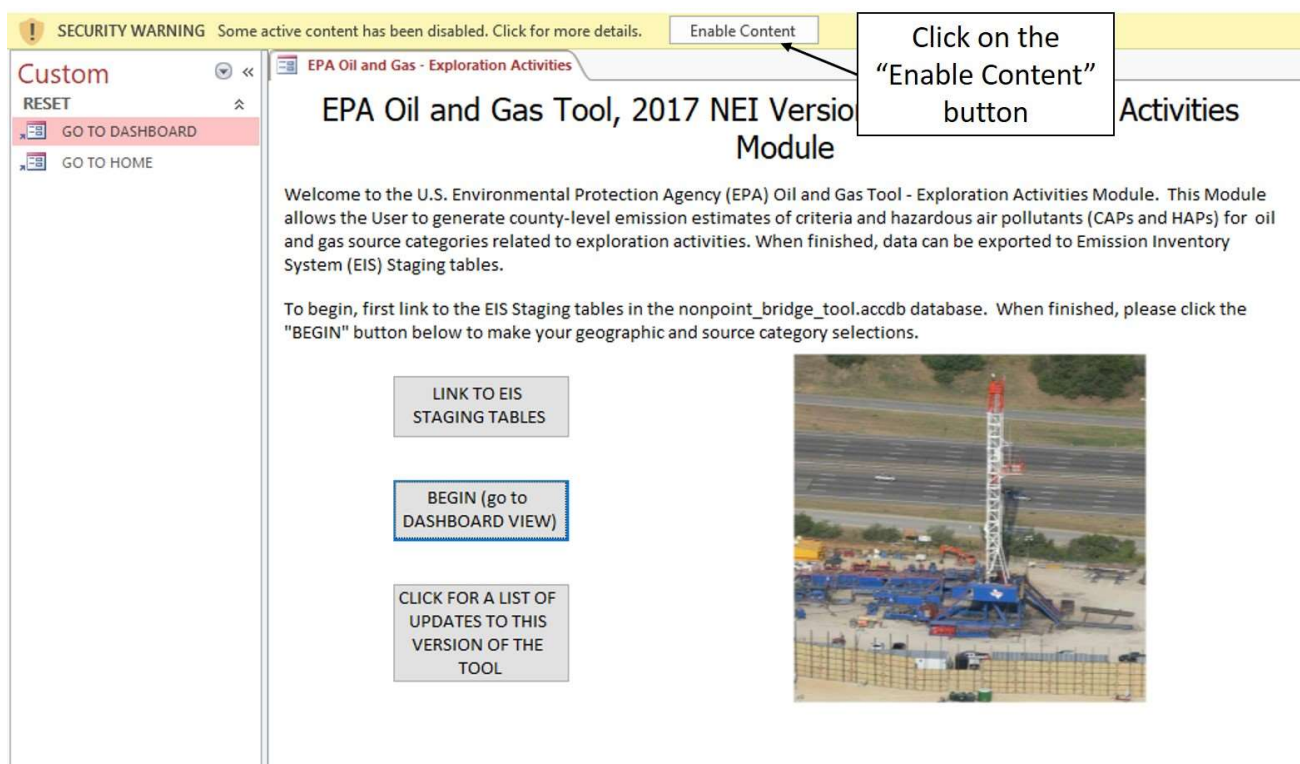
- a. Click on the “Reset All Selections/Go to Step 1” button at the top of the Dashboard; and
- b. Compact and Repair the database.

## Nonpoint Oil and Gas Emissions Estimation Tool

### 4.1 Preparation

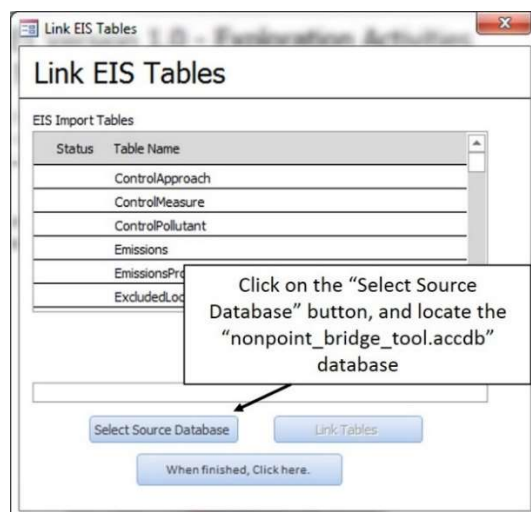
Prior to running the tool, the User must properly link the data tables in the Nonpoint Emissions Staging Tables within the tool. To do this, follow the instructions below:

- 1) Place both the “OIL\_GAS\_TOOL\_2017\_NEI\_EXPLORATION\_V1\_0.accdb” and the “nonpoint\_bridge\_tool.accdb” database tables in the same directory. It is recommended that the User creates an “EPA\_OIL\_GAS\_2017” directory on their hard drive.
- 2) Open the “OIL\_GAS\_TOOL\_2017\_NEI\_EXPLORATION\_V1\_0.accdb” database. You will need to “Enable Content” if the message pops up.

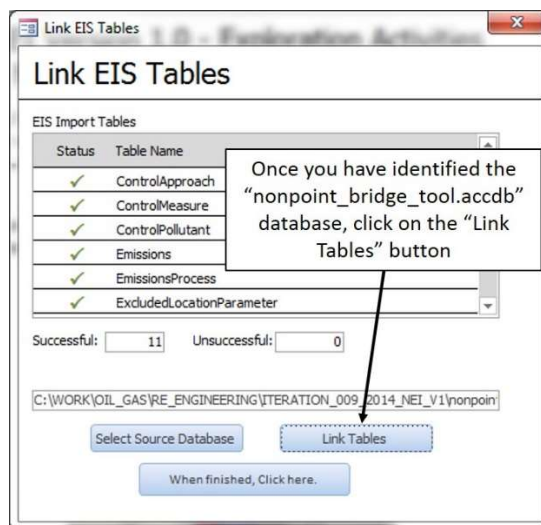


- 3) Click on the “LINK TO EIS STAGING TABLES” button, and a pop-up box will appear. Follow the instructions to link in the EIS Staging tables in the “nonpoint\_bridge\_tool.accdb” database (see figure below). If successfully linked, 11 tables will be linked.

## Nonpoint Oil and Gas Emissions Estimation Tool



- 4) Once you have identified the location of the "nonpoint\_bridge\_tool.accdb" database to link, click on the "Link Tables" button. If successful, 11 tables will be linked. When finished click on the "When finished, Click here." button.



- 5) Click the "BEGIN (go to DASHBOARD VIEW)" button to go to the Dashboard View.
- 6) In the Dashboard View, there are 10 tabs labeled Steps 1 through 10. The User will need to follow all ten steps in order to generate the emission estimates.

### 4.2 Steps to Generate Emissions

- 1) Step 1 - Select the Geographic Level. In Step 1, the User selects the geographic-level of the emissions inventory based on interest. On this page, the User will see some of the Geographic Area Type maps, which include: EIA Supply Region; EPA Regional Offices; NEMS Regions; Ozone Attainment Status; Regional Planning Organization; or Subpart W Basin. Most Users will select the "STATE" view. When finished, click the "When finished, click here to complete this step." button. A message box will appear instructing the User to proceed to Step 2.

## Nonpoint Oil and Gas Emissions Estimation Tool

**Geographic and Source Selections**

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 1 – Select a geographic level.

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data

Please select the geographic level at which you are generating emission estimates.

AREA_TYPE	PICK_ONE
EIA SUPPLY REGION	<input type="checkbox"/>
EPA REGION	<input type="checkbox"/>
NATIONWIDE	<input type="checkbox"/>
NEMS REGION	<input checked="" type="checkbox"/>
OZONE ATTAINMENT STATUS	<input type="checkbox"/>
REGIONAL PLANNING ORGANIZATION	<input type="checkbox"/>
STATE	<input type="checkbox"/>
SUBPART W BASIN	<input type="checkbox"/>
*	<input type="checkbox"/>

Record: 14 4 of 8   No Filter   Search

When finished, click here to complete this step.

After making the selection, click this button.

**EIA Supply Region**

Source: U.S. Energy Information Administration, Office of Energy Analysis

- 2) **Step 2 – Select Specific Geographic Location.** Click the “Step 2 – Select Specific Geographic Location” tab to continue. In Step 2, the User selects the specific geographic location of interest. The User may select more than specific location. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 3.

**Geographic and Source Selections**

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 2 – Select the specific geographic location(s)

AREA_TYPE	AREA_DESCRIPTION	PICK_AT_LEAST_ONE
STATE	AK	<input type="checkbox"/>
STATE	AL	<input type="checkbox"/>
STATE	AR	<input type="checkbox"/>
STATE	AZ	<input type="checkbox"/>
STATE	CA	<input type="checkbox"/>
STATE	CO	<input type="checkbox"/>
STATE	CT	<input type="checkbox"/>
STATE	DC	<input type="checkbox"/>
STATE	DE	<input type="checkbox"/>
STATE	FL	<input type="checkbox"/>
STATE	GA	<input type="checkbox"/>
STATE	HI	<input type="checkbox"/>
STATE	IA	<input type="checkbox"/>
STATE	ID	<input type="checkbox"/>
STATE	IL	<input type="checkbox"/>
STATE	IN	<input type="checkbox"/>
STATE	KS	<input type="checkbox"/>
STATE	KY	<input type="checkbox"/>
STATE	LA	<input type="checkbox"/>
STATE	MA	<input type="checkbox"/>
STATE	MD	<input type="checkbox"/>
STATE	ME	<input type="checkbox"/>
STATE	MI	<input type="checkbox"/>

When finished, click here to complete this step.

After making the selection(s), click this button.

## Nonpoint Oil and Gas Emissions Estimation Tool

- 3) **Step 3 – Select the Source Category Level.** Click the “Step 3 – Select Source Category Level” tab to continue. In Step 3, the User can either pick to generate emission estimates for all oil and gas exploration source categories or individually select source categories. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 4.

Geographic and Source Selections

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data

Please select the source category level at which you are generating emission estimates.

SOURCE_CATEGORY	PICK_ONE
ALL OIL AND GAS EXPLORATION SOURCE CATEGORIES	<input checked="" type="checkbox"/>
SELECT OIL AND GAS EXPLORATION SOURCE CATEGORIES	<input type="checkbox"/>
*	<input type="checkbox"/>

When finished, click here to complete this step.

After making the selection(s), click this button.

- 4) **Step 4 – Select Specific Source Category.** Click the “Step 4 – Select Specific Source Category” tab to continue. In Step 4, the User can select the specific Source Categories to generate emission estimates. If in Step 3, the User selected “ALL OIL AND GAS EXPLORATION SOURCE CATEGORIES”, then all source categories will be checked. At this point, the User may choose to deselect certain source categories. When finished, click the “When finished, press here” button. A message box will appear instructing the User to proceed to Steps 5, 6, and 7 to review/edit the activity data, basin factors, and emission factors; or to proceed directly to Step 8 for Point Source Activity Adjustments.

Geographic and Source Selections

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data

Please select the specific source categor(ies) for which you are generating emission estimates.

SOURCE_CATEGORY	SCC	SCC_DESCRIPTION	PICK_AT_LEAST_ONE
DRILL RIGS	2310000220	Oil And Gas Exploration Drill Rigs	<input checked="" type="checkbox"/>
HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & Prod /All Processes /Hydraulic Fracturing Engines	<input checked="" type="checkbox"/>
MUD DEGASSING	2310023606	On-Shore CBM Exploration /Mud Degassing	<input checked="" type="checkbox"/>
MUD DEGASSING	2310111100	On-Shore Oil Exploration /Mud Degassing	<input checked="" type="checkbox"/>
MUD DEGASSING	2310121100	On-Shore Gas Exploration /Mud Degassing	<input checked="" type="checkbox"/>
WELL COMPLETIONS	2310023600	On-Shore CBM Exploration: CBM Well Completion: All Processes	<input checked="" type="checkbox"/>
WELL COMPLETIONS	2310111700	On-Shore Oil Exploration: Oil Well Completion: All Processes	<input checked="" type="checkbox"/>
WELL COMPLETIONS	2310121700	On-Shore Gas Exploration: Gas Well Completion: All Processes	<input checked="" type="checkbox"/>
*			

When finished, press here

After making the selection(s), click this button.

If in Step 3, the User selected “SELECT OIL AND GAS EXPLORATION SOURCE CATEGORIES”, then no source categories will be checked. At this point, the User will select one or more source categories.

## Nonpoint Oil and Gas Emissions Estimation Tool

When finished, click the “When finished, press here” button. A message box will appear instructing the User to proceed to Steps 5, 6, and 7 to review/edit the activity data, basin factors, and emission factors; or to proceed directly to Step 8 for Point Source Activity Adjustments.

**Oil and Gas Tool: Exploration Activities - Dashboard View**

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   **Step 4 - Select Specific Source Category**   Step 5 - View/Edit County-Level Activity Data

Please select the specific source category(ies) for which you are generating emission estimates.

SOURCE_CATEGORY	SCC	SCC_DESCRIPTION	PICK_AT_LEAST_ONE
DRILL RIGS	2310000220	Oil And Gas Exploration Drill Rigs	<input type="checkbox"/>
HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & Prod /All Processes /Hydraulic Fracturing Engines	<input type="checkbox"/>
MUD DEGASSING	2310023606	On-Shore CBM Exploration /Mud Degassing	<input type="checkbox"/>
MUD DEGASSING	2310111100	On-Shore Oil Exploration /Mud Degassing	<input type="checkbox"/>
MUD DEGASSING	2310121100	On-Shore Gas Exploration /Mud Degassing	<input type="checkbox"/>
WELL COMPLETIONS	2310023600	On-Shore CBM Exploration: CBM Well Completion: All Processes	<input type="checkbox"/>
WELL COMPLETIONS	2310111700	On-Shore Oil Exploration: Oil Well Completion: All Processes	<input type="checkbox"/>
WELL COMPLETIONS	2310121700	On-Shore Gas Exploration: Gas Well Completion: All Processes	<input type="checkbox"/>

When finished, press here

After making the selection(s), click this button.

- 5) Step 5 – View/Edit County-Level Activity Data. Click the “Step 5 – View/Edit County-Level Activity Data” tab to continue. In Step 5, the User can view and edit the activity data that EPA has compiled for the geographic area and source categories selected.

**Oil and Gas Tool: Exploration Activities - Dashboard View**

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   **Step 5 - View/Edit County-Level Activity Data**

Please select the source category you would like to view/edit.

**Oil and Gas Exploration Sources - County-Level Activity Data**

Click on the county-level data set you wish to view/edit.

Drilling and Mud Degassing Activity   Well Completions and Hydraulic Fracturing Activity

When finished, please continue to Step 6 to View/Edit Basin Factors.

Pick a type of production dataset

To continue with this step, the User will need to pick an activity dataset to view/edit. If the “Drilling and Mud Degassing Activity” button is chosen, the User will then be asked to choose a well type.

## Nonpoint Oil and Gas Emissions Estimation Tool

Geographic and Source Selections | County Level Activity Data Sets

### COUNTY-LEVEL DRILLING AND MUD DEGASSING ACTIVITY DATA ENTRY FORM

Click on the county-level well type data set you wish to view/edit.

Oil Wells | Gas Wells | CBM Wells

When finished, click here

Once the well type is selected, an Activity Data form will appear that the User can view or edit. To get to the next county, at the bottom of the screen is the record number. Use the triangle arrows to move through the counties.

Geographic and Source Selections | County Level Activity Data Sets | Activity Data - Oil Wells

### COUNTY-LEVEL DRILLING AND MUD DEGASSING ACTIVITY DATA ENTRY FORM - OIL WELLS

State Abbreviation: **AR**

State and County FIPs Code: **05027**

County Name: **Columbia**

Basin Name: **Louisiana-Mississippi Salt Basins**

Year: **2017**

Filter for this Basin only | Remove Basin Filter

Import/Export Data...

	Current Value	Current-Value Reference	2014 Value	2014-Reference	
County-Level Oil Well Spud Counts, Vertical Drilled Wells	21	HPDI_2016	21	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Horizontal Drilled Wells	0	HPDI_2016	0	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Directional Drilled Wells	41	HPDI_2016	41	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Unknown Drilled Wells	0	HPDI_2016	0	HPDI_2016	Mud Degassing
County-Level Oil Well Depth Drilled, Vertical Drilled Wells	104,882.00	HPDI_2016_RIGDATA	104,882.00	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Horizontal Drilled Wells	0.00	HPDI_2016_RIGDATA	0.00	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Directional Drilled Wells	204,769.70	HPDI_2016_RIGDATA	204,769.70	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Unknown Drilled Wells	0.00	HPDI_2016_RIGDATA	0.00	HPDI_2016_RIGDATA	Drilling Rigs

If new values are entered, please enter a reference.

When finished, click here

The User may also edit activity data in MS-Excel by using the "Import/Export Data..." button.

## Nonpoint Oil and Gas Emissions Estimation Tool

Geographic and Source Selections

County Level Activity Data Sets

Activity Data - Oil Wells

COUNTY-LEVEL DRILLING AND MUD DEGASSING ACTIVITY DATA ENTRY FORM - OIL WELLS

State Abbreviation

AR

State and County FIPs Code

05027

County Name

Columbia

Basin Name

Louisiana-Mississippi Salt Basins

Filter for this Basin only

Remove Basin Filter

Year

2017

Import/Export Data...

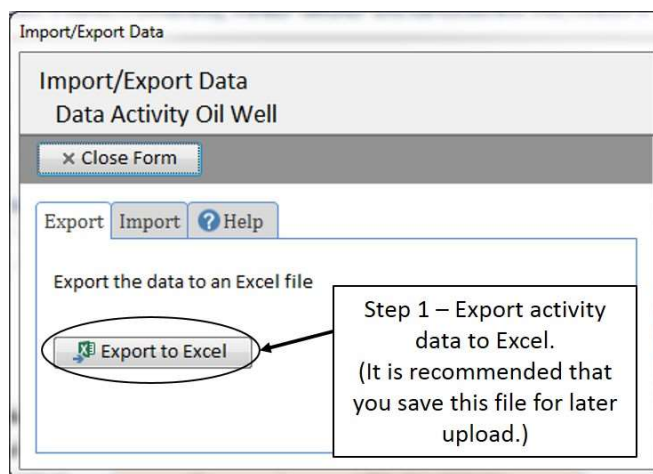
Values here can be edited.

	Current Value	Current Value Reference	2014 Value	2014 Reference	Applicable Source Categories
County-Level Oil Well Spud Counts, Vertical Drilled Wells	21	HPDI_2016	21	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Horizontal Drilled Wells	0	HPDI_2016	0	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Directional Drilled Wells	41	HPDI_2016	41	HPDI_2016	Mud Degassing
County-Level Oil Well Spud Counts, Unknown Drilled Wells	0	HPDI_2016	0	HPDI_2016	Mud Degassing
County-Level Oil Well Depth Drilled, Vertical Drilled Wells	104,882.00	HPDI_2016_RIGDATA	104,882.00	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Horizontal Drilled Wells	0.00	HPDI_2016_RIGDATA	0.00	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Directional Drilled Wells	204,769.70	HPDI_2016_RIGDATA	204,769.70	HPDI_2016_RIGDATA	Drilling Rigs
County-Level Oil Well Depth Drilled, Unknown Drilled Wells	0.00	HPDI_2016_RIGDATA	0.00	HPDI_2016_RIGDATA	Drilling Rigs

When finished, click here

## Nonpoint Oil and Gas Emissions Estimation Tool

If the user elects to edit activity data in MS-Excel, after clicking the button, the data is then exported into MS-Excel as shown below.



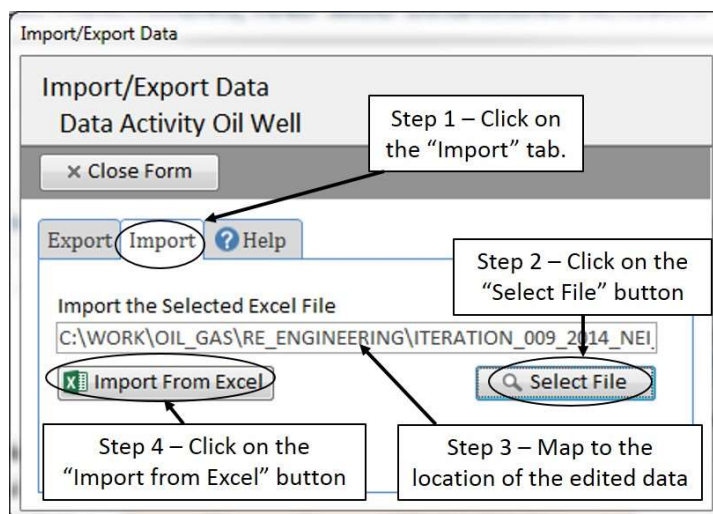
A MS-Excel workbook will open when finished exporting. It is required that the User save this file to the hard drive for later upload. In the Excel file, the User can only edit the yellow shaded cells. When completed, simply save the file.

STATE_ABBR	STATE_COUNTY_FIPS	COUNTY_NAME	BASIN	YEAR	DATA_CATEGORY	PREVIOUS_VALUE	PREVIOUS_REFERENCE	CURRENT_VALUE	CURRENT_REFERENCE
AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05001	Arkansas	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05003	Ashley	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05005	Baxter	Ozark Uplift	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05005	Baxter	Ozark Uplift	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05007	Benton	Ozark Uplift	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05007	Benton	Ozark Uplift	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05009	Boone	Ozark Uplift	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05009	Boone	Ozark Uplift	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05011	Bradley	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05013	Calhoun	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05015	Carroll	Ozark Uplift	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05015	Carroll	Ozark Uplift	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05017	Chicot	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05019	Clark	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05019	Clark	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05021	Clay	Illinois Basin	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05021	Clay	Illinois Basin	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05023	Cleburne	Arkoma Basin	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05023	Cleburne	Arkoma Basin	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05025	Cleveland	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05025	Cleveland	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05027	Columbia	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	41	HPDI_2016	41	HPDI_2016
AR	05027	Columbia	Louisiana-Mississippi Salt Basins	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	204769.7	HPDI_2016_RIGDATA	204769.7	HPDI_2016_RIGDATA
AR	05029	Conway	Arkoma Basin	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016
AR	05029	Conway	Arkoma Basin	2017	County-Level Oil Well Depth Drilled, Directional Drilled Wells	0	HPDI_2016_RIGDATA	0	HPDI_2016_RIGDATA
AR	05031	Craighead	Illinois Basin	2017	County-Level Oil Well Spud Counts, Directional Drilled Wells	0	HPDI_2016	0	HPDI_2016

If data edits were made, then the User will need to go back to the Tool and click on the “Import/Export Data...” button to initiate importing the edited data file. After clicking, the Import/Export form will appear. The User will need to:

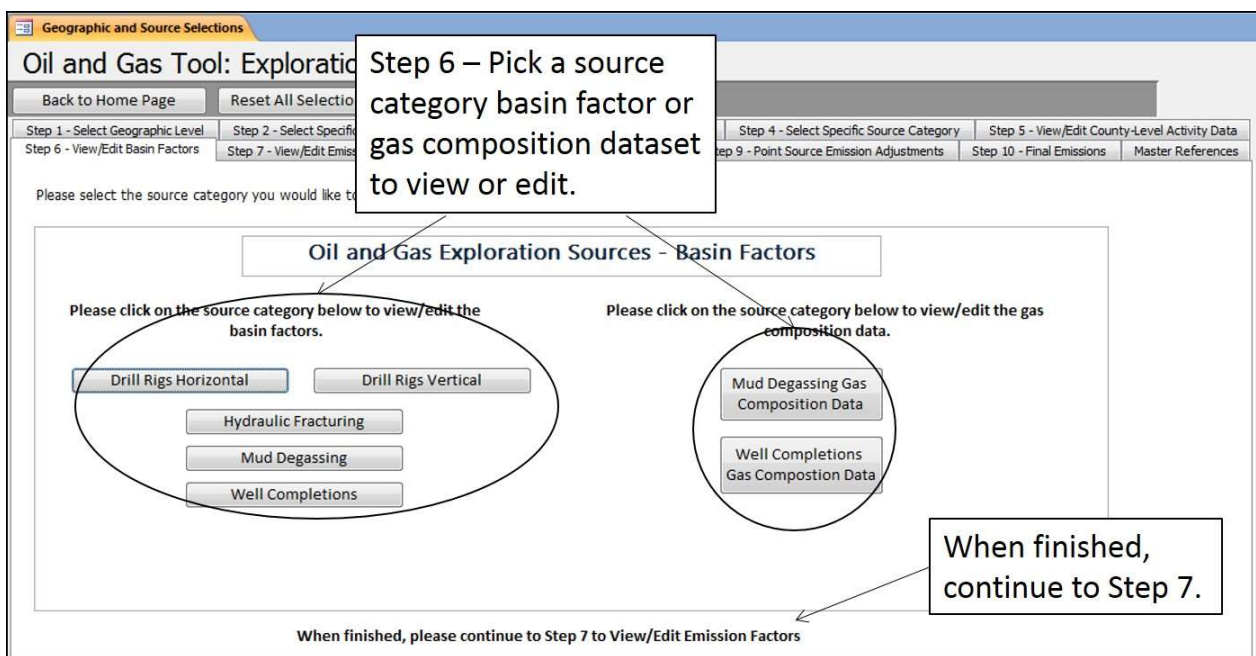
- Step 1 - Click on the “Import” tab,
- Step 2 - Click the “Select File” button
- Step 3 – Map to the location of the edited data, and click “OK”
- Step 4 – Click on the “Import from Excel” button

## Nonpoint Oil and Gas Emissions Estimation Tool



The edited data is now imported into the Tool.

- 6) Step 6 – View/Edit Basin Factors. Click the "Step 6 – View/Edit Basin Factors" tab to continue. In Step 6, the User can view and edit the basin factor data that EPA has compiled for the geographic area and source categories selected.



## Nonpoint Oil and Gas Emissions Estimation Tool

In the Basin Factors form, the User can view/edit the data. If the User updates values for one county in a basin, then all other counties in the basin and state can be updated by clicking on the “Click to apply these values to all other counties in the same basin for the state.” button. Additionally, the User can export and import data to MS-Excel similar to the procedure outlined in Step 5.

Geographic and Source Selections Basin Factors - Horizontal Drilling

### HORIZONTAL DRILLING RIGS BASIN FACTORS FORM

State Abbreviation

State and County FIPs Code

County Name

Basin Name

	Current Value	Current Value Reference	EPA Default Value	EPA Default Value Reference	2014 Value	2014 Value Reference
Horizontal-Drill Rig Spud Depth (ft/spud)	8800.0	CENSARA_STUDY_2012	8690.0	CENSARA_STUDY_2012_AVERAGE	8800.0	CENSARA_STUDY_2012
Horizontal-Drill Rig Spud Duration (hrs)	165	CENSARA_STUDY_2012	526	CENSARA_STUDY_2012_AVERAGE	165	CENSARA_STUDY_2012
Horizontal-Drill Rig Fuel Consumed (gallons)	7245	CENSARA_STUDY_2012	30713	CENSARA_STUDY_2012_AVERAGE	7245	CENSARA_STUDY_2012
Horizontal-Draw Rig Horsepower (HP)	1422	CENSARA_STUDY_2012	558	CENSARA_STUDY_2012_AVERAGE	1122	CENSARA_STUDY_2012
Horizontal-Draw Rig Load Factor	0.67	CENSARA_STUDY_2012	0.58	CENSARA_STUDY_2012_AVERAGE	0.67	CENSARA_STUDY_2012
Number of Horizontal-Draw Rig Engines (count/rig)	2	CENSARA_STUDY_2012	2	CENSARA_STUDY_2012_AVERAGE	2	CENSARA_STUDY_2012
Horizontal-Draw Spud Duration (hrs/spud)	536.2	CENSARA_STUDY_2012	290	CENSARA_STUDY_2012_AVERAGE		
Horizontal-Drill Rig Mud Pumps Horsepower (HP)	0	CENSARA_STUDY_2012				
Horizontal-Drill Rig Mud Pumps Load Factor	0	CENSARA_STUDY_2012				
Horizontal-Drill Number of Mud Pump Engines (count/rig)	0	CENSARA_STUDY_2012				
Horizontal-Drill Rig Spud Duration (hrs/spud)	0	CENSARA_STUDY_2012	130	CENSARA_STUDY_2012_AVERAGE		
Diesel-Electric Horizontal Drill Rigs Horsepower (HP)	0	CENSARA_STUDY_2012	772	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Rigs Load Factor	0	CENSARA_STUDY_2012	0.6	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Number of Engines (count/rig)	0	CENSARA_STUDY_2012	2	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Spud Duration (hrs/spud)	0	CENSARA_STUDY_2012	200	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Rigs Horsepower (HP)	0	CENSARA_STUDY_2012	1500	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Rigs Load Factor	0	CENSARA_STUDY_2012	0	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Number of Engines (count/rig)	0	CENSARA_STUDY_2012	3	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012
Diesel-Electric Horizontal Drill Spud Duration (hrs/spud)	0	CENSARA_STUDY_2012	0	CENSARA_STUDY_2012_AVERAGE	0	CENSARA_STUDY_2012

If new values are entered, please enter a reference.

EPA default values cannot be edited.

Values from the 2014 Tool. Values here cannot be edited.

Similarly, the User can view/edit the gas composition data for select categories.

- 7) Step 7 – View/Edit Emission Factors. Click the “Step 7 – View/Edit Emission Factors” tab to continue. In Step 7, the User can view or edit the emission factors that are used to generate the emission estimates for the source categories selected.

## Nonpoint Oil and Gas Emissions Estimation Tool

Geographic and Source Selections

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category   Step 4 - Select Emission Factor Category   Step 5 - View/Edit County-Level Activity Data   Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - View/Edit Final Emissions   Step 10 - Final Emissions   Master References

Please select the emission factor source category you would like to view/edit.

#### Oil and Gas Exploration Sources - Emission Factors

Please click on a Source Category below to view/edit emission factors.

- Drill Rigs
- Hydraulic Fracturing
- Mud Degassing
- Well Completions

When finished, please continue to Step 8 for Point Source Activity Adjustments

When finished, continue to Step 8.

## Nonpoint Oil and Gas Emissions Estimation Tool

Once a Source Category has been selected, the User can view or edit the emission factors. Remember to update the reference field (EMISSION\_FACTOR\_SOURCE) for any updated emission factors.

Geographic and Source Selections | FORM\_HYDRAULIC\_FRACTURING\_EF

### HYDRAULIC FRACTURING EMISSION FACTORS FORM

ST	BASIN	ATTAINMENT_ST	SOURCE_CATEGORY	SCC	SCC_SHORTENI	POLLUTANT_CATEGORY_NA	Pi	POLLUTA	EMISSION_FACTOR	EMISSION_FACTOR_SOURCE	EMISSION_FACTOR_UNITS
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Methane	Met CH4			0.006 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Methanol	Met 67561			0.0001204 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Naphthalene	Nap 91203			0.0003312 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Toluene	Nick 7440020			4.313E-06 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Nitrogen Oxides	Nitr N2O			5.831 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Nitrogen Dioxide	Nitr N2O			0.013 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Sulfur Dioxide	Sulf SO2			2.8829E-05 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Carbon Monoxide	PM1 PM25-PM10			0.227 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Propionaldehyde	Prop 123386			0.22 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Selenium Compounds	Sele 7782492			0.00368 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Styrene	Styr 100425			2.27E-06 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Sulfur Dioxide	Sulf SO2			0.0002208 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Toluene	Tolu 108883			0.01 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Volatile Organic Compounds	Tolu 108883			0.00559 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Xylenes (Mixed Isomers)	Vol VOC			0.368 G	HP-HR	
AR	Illinois Basin	ATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F 1,3-Butadiene	Xyle 1330207			0.00444 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F 2,2,4-Trimethylpentane	1,3-I 106990			0.000736 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Acetaldehyde	2,2,4 540841			0.001104 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Antimony Compounds	Acet 75070			0.027232 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Arsenic Compounds	Anti 7440369			8.172E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Benzene	Arse 7440382			1.135E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Cadmium Compounds	Ben 71432			0.00385 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Carbon Dioxide	Cadi 7440439			9.08E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Carbon Monoxide	Cart CO2			529.928 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Carbon Monoxide	Cart CO			1.318 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Chlorine	Chlc 7782505			7.8088E-05 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Chlorine Compounds	Cob 7440484			2.497E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Chlorine	Cum 98828			0.0000736 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Benzene	Ethy 100414			0.000659 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Formaldehyde	Form 50000			0.0313 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Hexane	Hex 110543			0.000736 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Lead Compounds	Leac 7439921			9.534E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Manganese Compounds	Man 7439965			9.08E-06 G	HP-HR	
AR	Illinois Basin	NONATTAINMENT	HYDRAULIC FRACTURING	2310000660	Oil & Gas Expl & F Manganese Compounds	Mar 7439976			6.91E-06 G	HP-HR	

Record: 1 of 68 | Filtered | Search

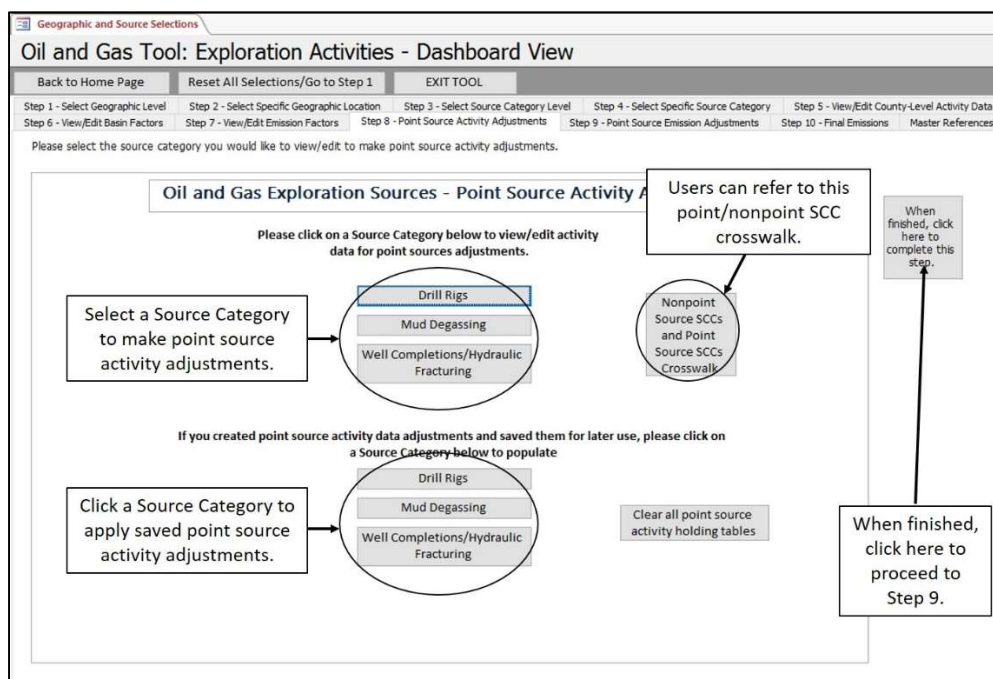
These emission factors can be edited. If changes are made, please update the reference.

Emission Factors are presented at the state, basin, and attainment status level.

When finished, click here

- 8) Step 8 – Point Source Activity Adjustments. Click the “Step 8 – Point Source Activity Adjustments” tab to continue. After the activity data, basin factors, and emission factors have been reviewed and/or updated, the User may enter point source activity adjustments to account for emissions that are to be reported to the point sources emissions inventory. If the User does not have any point source activity adjustments, then they will need to click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 9.

## Nonpoint Oil and Gas Emissions Estimation Tool



Currently, ALL point source activity adjustments (e.g. county-level point source spud counts, county-level point source feet drilled, county-level well completions, etc.) are defaulted to zero (i.e., no point source activity adjustments).

The screenshot shows the 'WELL COMPLETIONS/HYDRAULIC FRACTURING POINT SOURCE ACTIVITY ADJUSTMENT FORM'. The form has tabs at the top: 'Geographic and Source Selections', 'FORM\_WELL\_COMPLETION\_PS\_ACTIVITY', and 'Activity Data - Well Completions'. The main title is 'WELL COMPLETIONS/HYDRAULIC FRACTURING POINT SOURCE ACTIVITY ADJUSTMENT FORM'. Below the title are input fields for: 'State abbreviation: AR', 'State and County FIPs Code: 05027', 'County name: Columbia', and 'Year: 2014'. On the left side, there are three labels: 'Point Source Well Completions from Oil Wells', 'Point Source Well Completions from Gas Wells', and 'Point Source Well Completions from CBM Wells'. In the center, there is a table with two columns: 'Point Sources Conventional Wells Value' and 'Point Sources Unconventional Wells Value\*'. The table has three rows, all with the value '0'. Below the table is a callout box: 'Enter the point sources activity data.' To the right of the table is a callout box: 'When finished, click here.' and another callout box: 'When finished, click here.'.

It is encouraged that point source activity adjustments have priority over point source emission adjustments. Additionally, Users should pay careful attention to ensure that the point source activity data is entered in the same units as the nonpoint activity data. Users should refer to the "Nonpoint Source SCCs and Point Source SCCs Crosswalk" button to identify point source SCCs. After any point source activity adjustments have been made, proceed to Step 9.

## Nonpoint Oil and Gas Emissions Estimation Tool

- 9) Step 9 – Point Source Emission Adjustments. Click the “Step 9 – Point Source Emission Adjustments” tab to continue. In Step 9, the User can make point source emission adjustments directly in the emission tables. Select a Source Category to open. If a User has no point source emissions adjustments, they may click on the “When finished, click here to complete this step” button.

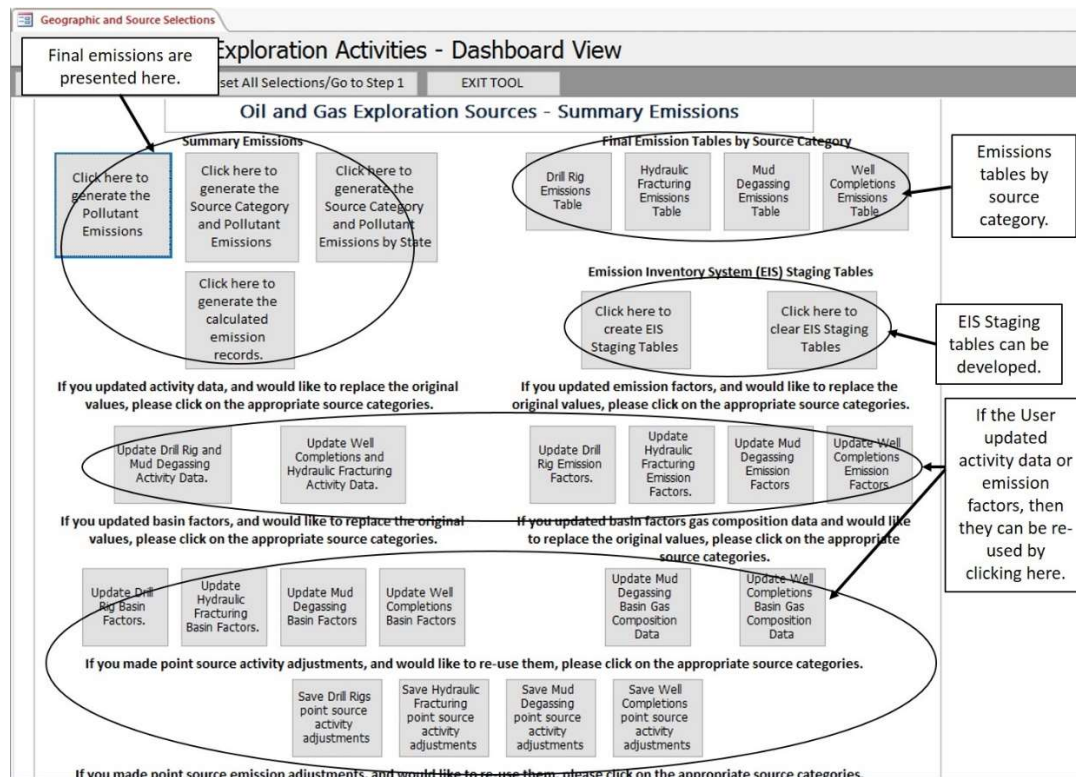
Point source emission estimates are to be entered in the “POINT\_EMISSIONS\_TPY” field. It is important to note that if point source activity adjustments were made in Step 8, then point source emission adjustments should NOT be made in these tables for overlapping SCCs. Also, point source emission adjustments need to be entered as tons per year (TPY).

STATE_COUNTY_FIPS	STATE_ABBR	COUNTY_NAME	SCC	SOURCE_CATEGORY	POLLUTANT_CODE	POINT_EMISSIONS_TPY
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	100414	Ethyl Benzene
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	108883	Toluene
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	1330207	Xylene
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	50000	Formaldehyde
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	73432	Benzene
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	7783064	Hydrogen Sulfide
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	CO	Carbon Dioxide
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	CO2	Carbon Dioxide
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	N2O	Nitrogen Dioxide
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	NOx	Nitrogen Oxides
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	SO2	Sulfur Dioxide
48439	TX	Tarrant	2310111700	WELL COMPLETIONS	VOC	Volatile Organic Compound
48439	TX	Tarrant	2310123700	WELL COMPLETIONS	100414	Ethyl Benzene
48439	TX	Tarrant				Toluene
48439	TX	Tarrant				Xylenes (Mixed Isomers)
48439	TX	Tarrant				Formaldehyde
48439	TX	Tarrant				Benzene
48439	TX	Tarrant				Hydrogen Sulfide
48439	TX	Tarrant				Methane
48439	TX	Tarrant				Carbon Monoxide
48439	TX	Tarrant				Carbon Dioxide
48439	TX	Tarrant				Nitrogen Dioxide
48439	TX	Tarrant				Nitrogen Oxides
48439	TX	Tarrant				Sulfur Dioxide
48439	TX	Tarrant				Volatile Organic Compound
48441	TX	Taylor				Ethyl Benzene
48441	TX	Taylor				Toluene
48441	TX	Taylor				Xylenes (Mixed Isomers)
48441	TX	Taylor				Formaldehyde

## Nonpoint Oil and Gas Emissions Estimation Tool

After point source emission adjustments are made (if applicable), then the User should proceed to Step 10.

- 10) Step 10 – Final Emissions. Click the “Step 10 – Final Emissions” tab to continue. In Step 10, the User can review the final emissions, update county-level activity data, emission factors, and basin factors that the User updated, retain point source activity and/or point source emission adjustments, or generate the Emission Inventory System (EIS) data tables.



Additional notes:

- 1) In the EIS Staging Tables, the ControlApproach, ControlMeasure, ControlPollutant, Emissions, EmissionsProcess, Location, and ReportingPeriod are populated.
- 2) EPA's EIS Nonpoint Bridge Tool (included in the .zip file) can be used to generate the .xml file needed for EIS upload.
- 3) If the User wishes to reset the tool, and regenerate the emissions, the following steps are recommended:
  - a. Click on the “Reset All Selections/Go to Step 1” button at the top of the Dashboard.
  - b. Compact and Repair the database.

## Nonpoint Oil and Gas Emissions Estimation Tool

**Geographic and Source Selections**

### Oil and Gas Tool: Exploration Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data  
 Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

Please select the type of summary emissions you would like to view, or to generate the EIS Staging tables.

#### Oil and Gas Exploration Sources - Summary Emissions

To return to the Home page, click here.

To reset the Tool, please click here.

To exit the Tool, click here.

Click here to generate the Source Category and Pollutant Emissions

Click here to generate the Source Category and Pollutant Emissions by State

Click here to generate the calculated emission records.

#### Emissions by Source Category

Drill Rig Emissions Table   Hydraulic Fracturing Emissions Table   Mud Degassing Emissions Table   Well Completions Emissions Table

#### Emission Inventory System (EIS) Staging Tables

Click here to create EIS Staging Tables   Click here to clear EIS Staging Tables

If you updated activity data, and would like to replace the original values, please click on the appropriate source categories.

If you updated emission factors, and would like to replace the original values, please click on the appropriate source categories.

4) References cited for the original data in the Tool are found in the “Master References” tab.

**Geographic and Source Selections**

### Oil and Gas Tool: Exploration Activities - Master References

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data  
 Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions   Master References

References are compiled into a single table. These references pertain to the original data in the Tool, and does not reflect references entered by the User.

FIELD_REFERENCE	FIELD_REFERENCE_DESCRIPTION
AK_OGC_2012	Alaska Oil and Gas Commission data
AK_OGC_2013_RIGDATA	Alaska Oil and Gas Commission drilling data scaled to Alaska state totals from RIGDATA
AL_OGC_2013_RIGDATA	Alabama Oil and Gas Commission drilling data scaled to Alabama state totals from RIGDATA
API_2009a	API Compendium (8/2009), Table 4-5
API_2009b	API Compendium (8/2009), Table 4-11
AR_DEQ_2013	Arkansas Oil and Gas Commission well completion reports
CA_OGC_2013	California Oil and Gas Commission data
CA_OGC_2013_RIGDATA	California Oil and Gas Commission drilling data scaled to California state totals from RIGDATA
CENRAP_2008	ENVIRON. Recommendations for Improvements to the CENRAP STATES' OIL AND GAS EMISSIONS INVENTORIES. November 2008
CENSARA_STUDY_2012	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 20
CENSARA_STUDY_2012_AVERAGE	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 20
CENSARA_STUDY_2012_EXTENSION	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 20
CLIMATE_REGISTRY_2010	The Climate Registry Oil and Gas Production Annex II to the General Reporting Protocol, 2010 - Table 17.5
EIA_2012	Energy Information Administration (EIA). 2012. Accessed online at: <a href="http://www.eia.gov/">http://www.eia.gov/</a>

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**APPENDIX B – INSTRUCTIONS FOR USING THE EPA NONPOINT OIL AND GAS EMISSIONS  
ESTIMATION TOOL, PRODUCTION MODULE (3/25/2019)**

## **Instructions for Using the 2017 EPA Nonpoint Oil and Gas Emissions Estimation Tool, Production Module (3/25/2019)**

### **5.0 Introduction**

Under Work Assignment with U.S. EPA, Eastern Research Group, Inc. (ERG) was tasked to develop a tool that state, local, and tribal (SLT) agencies could use to develop a nonpoint source emission inventory for upstream oil and natural gas activities. To this end, ERG prepared the EPA Nonpoint Oil and Gas Emissions Estimation Tool for the 2011 base year to assist agencies in compiling, allocating, and adjusting upstream oil and natural gas activity data, and developing county-level nonpoint source emission estimates.

In support of the 2014 NEI, U.S. EPA directed ERG to redesign the Tool to enhance the User experience. Such enhancements included, but were not limited to: 1) the development of a “Dashboard View” to guide the User; 2) the creation of data entry forms; 3) the creation of a MS Excel-based data import/export utility; 4) ability to view EPA default data; and 5) more flexibility in how data are presented. As part of this work and to increase the efficiency, the Tool was split into two separate modules (i.e., two separate databases): exploration activities and production activities. These instructions address use of the production module.

For the 2017 NEI, U.S. EPA directed ERG to build upon the re-engineered Production and Exploration Tools to reflect 2017 activity, as well as include additional PM species, update county FIPS code changes, and include new source categories and pollutants, when available. The tool generated estimates for 55 source classification codes (SCCs) and 70 pollutants. Where state or local data were not submitted to the NEI, EPA uses the estimates generated for inclusion in the 2017 NEI.

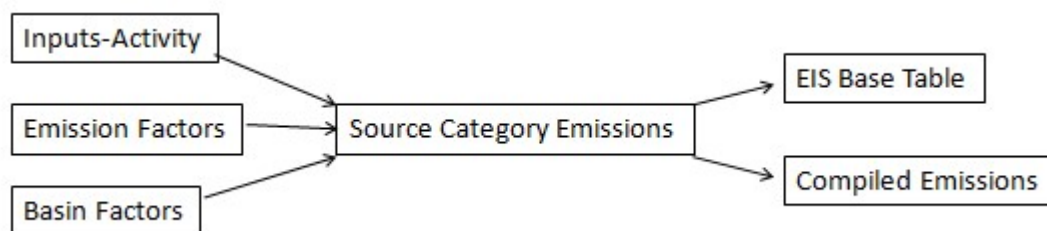
### **6.0 MS-Access Databases**

The Nonpoint Oil and Gas Emissions Estimation Tools were programmed in MS-Access. This platform offered several advantages, particularly in accessibility (software is available to most users), familiarity (MS-Access is used by most SLT agencies in preparation of Emission Inventory System (EIS) data files), and portability (the tool modules can be e-mailed as zipped files that are less than 25 MB each in size).

Included with the tool are the Nonpoint Emissions blank staging tables which are to be used for preparation of EIS data files.

### **7.0 Tool Data Flow**

The basic concept of the tool is to calculate the source category emissions using the activity data, emission factors, and basin factors. A conceptual flow is:



### **8.0 Steps for Using the Oil and Natural Gas Tool for Production Sources to Generate Emissions**

In this section, steps will be outlined to generate emissions from the Production sources.

### **Nonpoint Oil and Gas Emissions Estimation Tool**

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Note: If the User will be editing an existing version of the database and wishes to reset the tool and regenerate the emissions, the following steps are recommended:

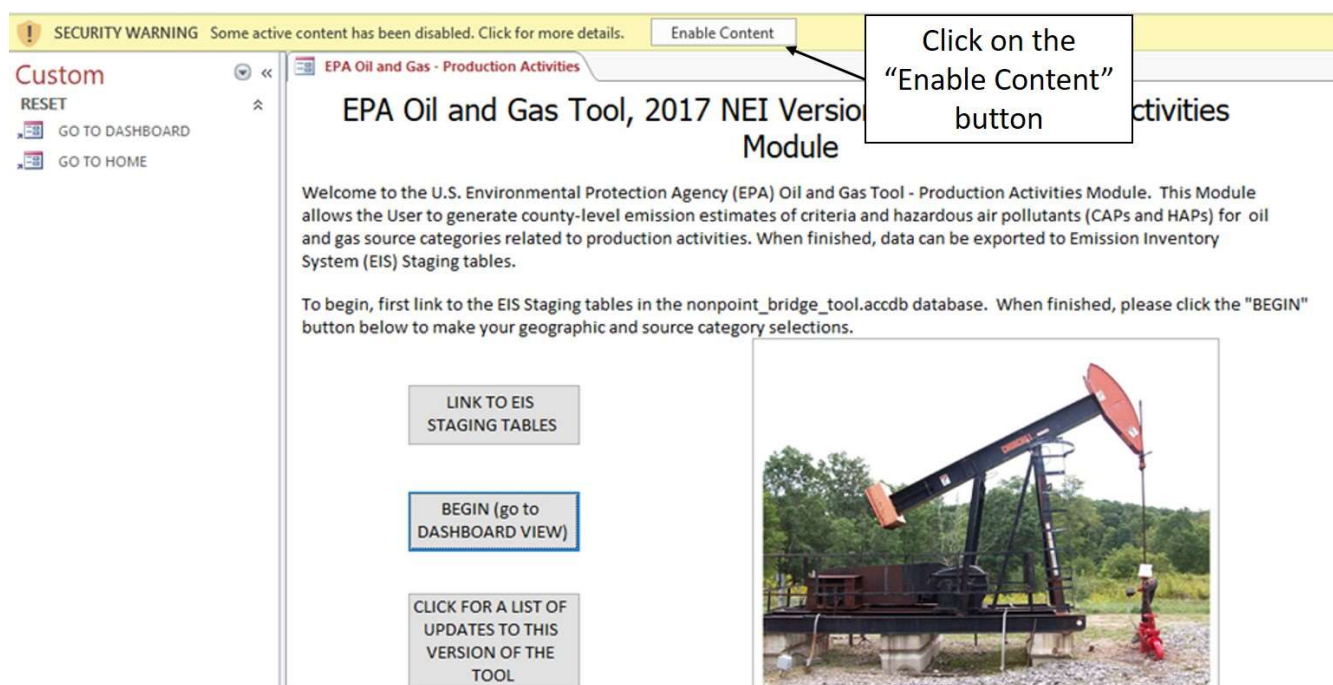
- c. Click on the “Reset All Selections/Go to Step 1” button at the top of the Dashboard; and
- d. Compact and Repair the database

## **Nonpoint Oil and Gas Emissions Estimation Tool**

### **8.1 Preparation**

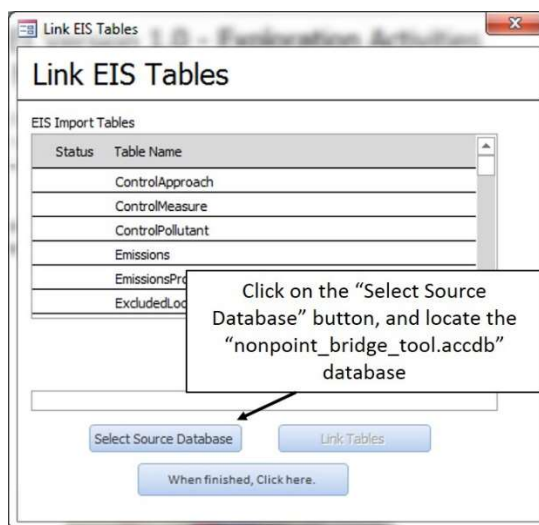
Prior to running the tool, the User must properly link the data tables in the Nonpoint Emissions Staging Tables within the tool. To do this, follow the instructions below:

- 7) Place both the “OIL\_GAS\_TOOL\_2017\_NEI\_PRODUCTION\_V1\_0.accdb” and the “nonpoint\_bridge\_tool.accdb” database tables in the same directory. It is recommended that the User creates an “EPA\_OIL\_GAS” directory on their hard drive.
- 8) Open the “OIL\_GAS\_TOOL\_2017\_NEI\_PRODUCTION\_V1\_0.accdb” database. You will need to “Enable Macros” if the message pops up.

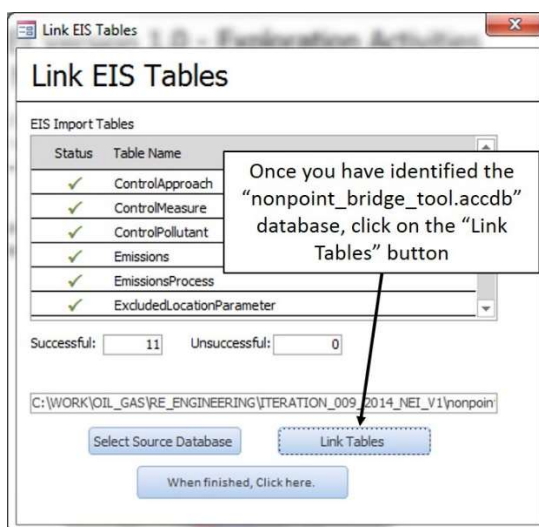


- 9) Click on the “LINK TO EIS STAGING TABLES” button, and a pop-up box will appear. Follow the instructions to link in the EIS Staging tables in the “nonpoint\_bridge\_tool.accdb” database (see figure below). If successfully linked, 11 tables will be linked.

## ***Nonpoint Oil and Gas Emissions Estimation Tool***



- 10) Once you have identified the location of the "nonpoint\_bridge\_tool.accdb" database to link, click on the "Link Tables" button. If successful, 11 tables will be linked. When finished click on the "When finished, Click here." button.



- 11) Click the "BEGIN (go to DASHBOARD VIEW)" button to go to the Dashboard View.
- 12) In the Dashboard View, there are 10 tabs labeled Steps 1 through 10. The User will need to follow all ten steps in order to generate the emission estimates.

### **8.2 Steps to Generate Emissions**

- 11) Step 1 - Select the Geographic Level. In Step 1, the User selects the geographic-level of the emissions inventory based on interest. On this page, the User will see some of the Geographic Area Type maps, which include: EIA Supply Region; EPA Regional Offices; NEMS Regions; Ozone Attainment Status; Regional Planning Organization; or Subpart W Basin. Most Users will select the "STATE" view. When

## Nonpoint Oil and Gas Emissions Estimation Tool

finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 2.

The screenshot shows the 'Oil and Gas Tool: Production Activities - Dashboard View' interface. The 'TOOL' tab is selected. The navigation bar includes buttons for 'Back to Home Page' and 'Reset All Selections/Go to Step 1'. The step navigation bar shows 'Step 1 - Select Geographic Level' as the active step, with 'Step 2 - Select Specific Geographic Location' as the next step. The main content area prompts the user to 'Please select the geographic level at which you are generating emission estimates.' It features a table with columns 'AREA\_TYPE' and 'PICK\_ONE'. The 'EIA SUPPLY REGION' is selected. To the right, there is a map of the United States titled 'EIA Supply Region' with color-coded regions: West Coast, Rocky Mountains, Midwest, Northeast, South, and Atlantic. A callout box points to a button labeled 'When finished, click here to complete this step.' Another callout box points to the 'PICK\_ONE' column header, stating 'After making the selection, click this button.'

AREA_TYPE	PICK_ONE
EIA SUPPLY REGION	<input checked="" type="checkbox"/>
EPA REGION	<input type="checkbox"/>
NATIONWIDE	<input type="checkbox"/>
NEMS REGION	<input type="checkbox"/>
OZONE ATTAINMENT STATUS	<input type="checkbox"/>
REGIONAL PLANNING ORGANIZATION	<input type="checkbox"/>
STATE	<input type="checkbox"/>
SUBPART W BASIN	<input type="checkbox"/>

- 12) **Step 2 – Select Specific Geographic Location.** Click the “Step 2 – Select Specific Geographic Location” tab to continue. In Step 2, the User selects the specific geographic location of interest. The User may select more than specific location. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 3.

The screenshot shows the 'Oil and Gas Tool: Production Activities - Dashboard View' interface, Step 2 - Select Specific Geographic Location. The 'TOOL' tab is selected. The navigation bar includes buttons for 'Back to Home Page', 'Reset All Selections/Go to Step 1', and 'EXIT'. The step navigation bar shows 'Step 2 - Select Specific Geographic Location' as the active step, with 'Step 3 - Select Source Category Level' as the next step. The main content area prompts the user to 'Please select the specific geographic location at which you are generating emission estimates.' It features a table with columns 'AREA\_TYPE', 'AREA\_DESCRIPTION', and 'PICK\_AT\_LEAST\_ONE'. The 'STATE' area type is selected, and the 'AREA\_DESCRIPTION' column lists US states from AK to KS. A callout box points to a button labeled 'When finished, click here to complete this step.' Another callout box points to the 'PICK\_AT\_LEAST\_ONE' column header, stating 'After making the selection(s), click this button.'

AREA_TYPE	AREA_DESCRIPTION	PICK_AT_LEAST_ONE
STATE	AK	<input type="checkbox"/>
STATE	AL	<input type="checkbox"/>
STATE	AR	<input type="checkbox"/>
STATE	AZ	<input type="checkbox"/>
STATE	CA	<input type="checkbox"/>
STATE	CO	<input type="checkbox"/>
STATE	CT	<input type="checkbox"/>
STATE	DC	<input type="checkbox"/>
STATE	DE	<input type="checkbox"/>
STATE	FL	<input type="checkbox"/>
STATE	GA	<input type="checkbox"/>
STATE	HI	<input type="checkbox"/>
STATE	IA	<input type="checkbox"/>
STATE	ID	<input type="checkbox"/>
STATE	IL	<input type="checkbox"/>
STATE	IN	<input type="checkbox"/>
STATE	KS	<input type="checkbox"/>

- 13) **Step 3 – Select the Source Category Level.** Click the “Step 3 – Select Source Category Level” tab to continue. In Step 3, the User can either pick to generate emission estimates for all oil and gas production source categories or individually select source categories. When finished, click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 4.

## Nonpoint Oil and Gas Emissions Estimation Tool

**Geographic and Source Selections**

### Oil and Gas Tool: Production Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Activity Data   Master References

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   **Step 3 - Select Source Category Level**   Step 4 - Select Specific Source Category

Please select the source category level at which you are generating emission estimates.

SOURCE_CATEGORY	PICK_ONE
ALL UPSTREAM PRODUCTION OIL AND GAS SOURCE CATEGORIES	<input type="checkbox"/>
SELECT UPSTREAM PRODUCTION OIL AND GAS SOURCE CATEGORIES	<input type="checkbox"/>
*	<input type="checkbox"/>

Records: 14   1 of 2   No Filter   Search

When finished, click here to complete this step.

After making the selection(s), click this button.

- 14) **Step 4 – Select Specific Source Category.** Click the “Step 4 – Select Specific Source Category” tab to continue. In Step 4, the User can select the specific Source Categories to generate emission estimates. If in Step 3, the User selected “ALL OIL AND GAS PRODUCTION SOURCE CATEGORIES”, then all source categories will be checked. At this point, the User may choose to deselect certain source categories. When finished, click the “When finished, press here” button. A message box will appear instructing the User to proceed to Steps 5, 6, and 7 to review/edit the activity data, basin factors, and emission factors; or to proceed directly to Step 8 for Point Source Activity Adjustments.

**Geographic and Source Selections**

### Oil and Gas Tool: Production Activities - Dashboard View

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 4 – All Source Categories are selected.

SOURCE_CATEGORY	SCC	SCC_DESCRIPTION	PICK_AT_LEAST_ONE
ARTIFICIAL LIFTS	2310000330	Oil & Gas Expl & Prod /All Processes /Artificial Lift	<input checked="" type="checkbox"/>
ASSOCIATED GAS	2310011000	On Shore Crude Oil Production All Processes	<input checked="" type="checkbox"/>
CBM DEWATERING PUMPS	2310023000	Coal Bed Methane NG / Dewatering Pump Engines	<input checked="" type="checkbox"/>
CONDENSATE TANKS	2310021010	On-Shore Gas Production /Storage Tanks: Condensate	<input checked="" type="checkbox"/>
CONDENSATE TANKS	2310023010	On-Shore CBM Production /Storage Tanks: Condensate	<input checked="" type="checkbox"/>
CRUDE OIL TANKS	2310010200	Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Tanks - Flashing & St	<input checked="" type="checkbox"/>
DEHYDRATORS	2310021400	On-Shore Gas Production Dehydrators	<input checked="" type="checkbox"/>
DEHYDRATORS	2310023400	Coal Bed Methane NG / Dehydrators	<input checked="" type="checkbox"/>
FUGITIVES	2310011501	On-Shore Oil Production /Fugitives: Connectors	<input checked="" type="checkbox"/>
FUGITIVES	2310011502	On-Shore Oil Production /Fugitives: Flanges	<input checked="" type="checkbox"/>
FUGITIVES	2310011503	On-Shore Oil Production /Fugitives: Open Ended Lines	<input checked="" type="checkbox"/>
FUGITIVES	2310011505	On-Shore Oil Production /Fugitives: Valves	<input checked="" type="checkbox"/>
FUGITIVES	2310021501	On-Shore Gas Production /Fugitives: Connectors	<input checked="" type="checkbox"/>
FUGITIVES	2310021502	On-Shore Gas Production /Fugitives: Flanges	<input checked="" type="checkbox"/>
FUGITIVES	2310021503	On-Shore Gas Production /Fugitives: Open Ended Lines	<input checked="" type="checkbox"/>
FUGITIVES	2310021505	On-Shore Gas Production /Fugitives: Valves	<input checked="" type="checkbox"/>
FUGITIVES	2310021506	On-Shore Gas Production /Fugitives: Other	<input checked="" type="checkbox"/>
FUGITIVES	2310023511	On-Shore CBM Production /Fugitives: Connectors	<input checked="" type="checkbox"/>

When finished, press here

After making the selection(s), click this button

## Nonpoint Oil and Gas Emissions Estimation Tool

If in Step 3, the User selected “SELECT OIL AND GAS PRODUCTION SOURCE CATEGORIES”, then no source categories will be checked. At this point, the User will select one or more source categories. When finished, click the “When finished, press here” button. A message box will appear instructing the User to proceed to Steps 5, 6, and 7 to review/edit the activity data, basin factors, and emission factors; or to proceed directly to Step 8 for Point Source Activity Adjustments.

**Oil and Gas Tool: Production Activities - Dashboard View**

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 4 – No Source Categories are selected.

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions  
 Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5

Please select the specific source categor(ies) for which you are generating emission estimates for.

SOURCE_CATEGORY	SCC	SCC_DESCRIPTION	PICK_AT_LEAST_ONE
ARTIFICIAL LIFTS	2310000330	Oil & Gas Expl & Prod /All Processes /Artificial Lift	<input type="checkbox"/>
ASSOCIATED GAS	2310011000	On Shore Crude Oil Production All Processes	<input type="checkbox"/>
CBM DEWATERING PUMPS	2310023000	Coal Bed Methane NG / Dewatering Pump Engines	<input type="checkbox"/>
CONDENSATE TANKS	2310021010	On-Shore Gas Production /Storage Tanks: Condensate	<input type="checkbox"/>
CONDENSATE TANKS	2310023010	On-Shore CBM Production /Storage Tanks: Condensate	<input type="checkbox"/>
CRUDE OIL TANKS	2310010200	Oil & Gas Expl & Prod /Crude Petroleum /Oil Well Tanks - Flashing & St	<input type="checkbox"/>
DEHYDRATORS	2310021400	On-Shore Gas Production Dehydrators	<input type="checkbox"/>
DEHYDRATORS	2310023400	Coal Bed Methane NG / Dehydrators	<input type="checkbox"/>
FUGITIVES	2310011501	On-Shore Oil Production /Fugitives: Connectors	<input type="checkbox"/>
FUGITIVES	2310011502	On-Shore Oil Production /Fugitives: Flanges	<input type="checkbox"/>
FUGITIVES	2310011503	On-Shore Oil Production /Fugitives: Open Ended Lines	<input type="checkbox"/>
FUGITIVES	2310011505	On-Shore Oil Production /Fugitives: Valves	<input type="checkbox"/>
FUGITIVES	2310021501	On-Shore Gas Production /Fugitives: Connectors	<input type="checkbox"/>
FUGITIVES	2310021502	On-Shore Gas Production /Fugitives: Flanges	<input type="checkbox"/>
FUGITIVES	2310021503	On-Shore Gas Production /Fugitives: Open Ended Lines	<input type="checkbox"/>
FUGITIVES	2310021505	On-Shore Gas Production /Fugitives: Valves	<input type="checkbox"/>
FUGITIVES	2310021506	On-Shore Gas Production /Fugitives: Other	<input type="checkbox"/>
FUGITIVES	2310023511	On-Shore CBM Production /Fugitives: Connectors	<input type="checkbox"/>
FUGITIVES	2310023512	On-Shore CBM Production /Fugitives: Flanges	<input type="checkbox"/>
FUGITIVES	2310023513	On-Shore CBM Production /Fugitives: Open Ended Lines	<input type="checkbox"/>
FUGITIVES	2310023515	On-Shore CBM Production /Fugitives: Valves	<input type="checkbox"/>

When finished, press here

After making the selection(s), click this button.

- 15) Step 5 – View/Edit County-Level Activity Data. Click the “Step 5 – View/Edit County-Level Activity Data” tab to continue. In Step 5, the User can view and edit the activity data that EPA has compiled for the geographic area and source categories selected.

**Oil and Gas Tool: Production Activities - Dashboard View**

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

Step 6 - View/Edit Basin Factors   Step 7 - View/Edit Emission Factors   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions  
 Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit County-Level Activity Data

Please click on the source category below to view/edit county-level activity data

Click here to review the Oil Production Data.

Click here to review the Natural Gas Production Data.

Click here to review the Coalbed Methane Production Data.

Click here to review the Produced Water Data.

Pick a type of production dataset

When finished, please continue to Step 6 to View/Edit Basin Factors

## Nonpoint Oil and Gas Emissions Estimation Tool

Once the county-level data set is selected, an Activity Data form will appear that the User can view or edit. To get to the next county, at the bottom of the screen is the record number. Use the triangle arrows to move through the counties.

The screenshot shows the 'Natural Gas Production Activity Data' form. It includes input fields for State Abbreviation (AR), State and County FIPs Code (05023), County Name (Cleburne), Basin Name (Arkoma Basin), and Year (2017). Below these fields are buttons for 'Filter for this Basin only' and 'Remove Basin Filter'. A table displays data for 'Current Value', 'Current Value Reference', '2014 Value', and '2014 Value Reference' for four categories: County-Level Natural Gas Production (MSCF), County-Level Condensate Production from natural gas wells (BBL), County-Level Natural Gas Well Counts, and Fraction of natural gas wells in the county needing compression. The table is annotated with a note: 'If new values are entered, please enter a reference.' and 'Values from the 2014 Tool. Values here cannot be edited.' A button 'When finished, click here' is located at the bottom right.

Geographic and Source Selections | Activity Data: Natural Gas

**Natural Gas Production Activity Data** When finished, click here

State Abbreviation: **AR**

State and County FIPs Code: **05023**

County Name: **Cleburne**

Basin Name: **Arkoma Basin**

Year: **2017**

The User can filter for specific basins.

Filter for this Basin only Remove Basin Filter

If new values are entered, please enter a reference.

Import/Export Data

Values from the 2014 Tool. Values here cannot be edited.

	Current Value	Current Value Reference	2014 Value	2014 Value Reference
County-Level Natural Gas Production (MSCF)	226,113,000.00	HPDI_2016	226,113,000.00	HPDI_2016
County-Level Condensate Production from natural gas wells (BBL)	0.00	HPDI_2016	0.00	HPDI_2016
County-Level Natural Gas Well Counts	889	HPDI_2016	889	HPDI_2016
Fraction of natural gas wells in the county needing compression	0.085	CENSARA_STUDY_2012	0.085	CENSARA_STUDY_2012

When finished, click here

## Nonpoint Oil and Gas Emissions Estimation Tool

The User may also edit activity data in MS-Excel by using the “Import/Export Data...” button.

Geographic and Source Selections | Activity Data: Natural Gas

### Natural Gas Production Activity Data

State Abbreviation:

State and County FIPs Code:

County Name:

Basin Name:

Year:

Values here can be edited.

	Current Value	Current Value Reference	2014 Value	2014 Value Reference
County-Level Natural Gas Production (MSCF)	226,113,000.00	HPDI_2016	226,113,000.00	HPDI_2016
County-Level Condensate Production from natural gas wells (BBL)	0.00	HPDI_2016	0.00	HPDI_2016
County-Level Natural Gas Well Counts	889	HPDI_2016	889	HPDI_2016
Fraction of natural gas wells in the county needing compression	0.085	CENSARA_STUDY_2012	0.085	CENSARA_STUDY_2012

If the user elects to edit activity data in MS-Excel, after clicking the button, the data is then exported into MS-Excel as shown below.

Import/Export Data

### Import/Export Data Activity: Natural Gas

Export the data to an Excel file

Step 1 – Export activity data to Excel.  
(It is recommended that you save this file for later upload.)

## Nonpoint Oil and Gas Emissions Estimation Tool

A MS-Excel workbook will open when finished exporting. It is required that the User save this file to the hard drive for later upload. In the Excel file, the User can only edit the yellow shaded cells. When completed, simply save the file.

A	B	C	D	E	F	G	H	I	J
STATE_ABBR	STATE_COUNTY_FIPS	COUNTY_NAME	BASIN	YEAR	DATA_CATEGORY	PREVIOUS_VALUE	PREVIOUS_REFERENCE	CURRENT_VALUE	CURRENT_REFERENCE
AR	05001	Arkansas	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05001	Arkansas	Louisiana-Mississippi Salt Ba	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05001	Arkansas	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05001	Arkansas	Louisiana-Mississippi Salt Ba	2017	Fraction of natural gas wells in the county needing compress	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
AR	05003	Ashley	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05003	Ashley	Louisiana-Mississippi Salt Ba	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05003	Ashley	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05003	Ashley	Louisiana-Mississippi Salt Ba	2017	Fraction of natural gas wells in the county needing compress	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
AR	05005	Baxter	Ozark Uplift	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05005	Baxter	Ozark Uplift	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05005	Baxter	Ozark Uplift	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05005	Baxter	Ozark Uplift	2017	Fraction of natural gas wells in the county needing compress	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
AR	05007	Benton	Ozark Uplift	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05007	Benton	Ozark Uplift	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05007	Benton	Ozark Uplift	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05007	Benton	Ozark Uplift	2017	Fraction of natural gas wells in the county needing compress	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
AR	05009	Boone	Ozark Uplift	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05009	Boone	Ozark Uplift	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05009	Boone	Ozark Uplift	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05009	Boone	Ozark Uplift	2017	Fraction of natural gas wells in the county needing compress	0.2082511	CENSARA_STUDY_2012	0.2082511	CENSARA_STUDY_2012
AR	05011	Bradley	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05011	Bradley	Louisiana-Mississippi Salt Ba	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016
AR	05011	Bradley	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Well Counts	0	HPDI_2016	0	HPDI_2016
AR	05011	Bradley	Louisiana-Mississippi Salt Ba	2017	Fraction of natural gas wells in the county needing compress	9.090909E-02	CENSARA_STUDY_2012	9.090909E-02	CENSARA_STUDY_2012
AR	05013	Calhoun	Louisiana-Mississippi Salt Ba	2017	County-Level Natural Gas Production (MSCF)	0	HPDI_2016	0	HPDI_2016
AR	05013	Calhoun	Louisiana-Mississippi Salt Ba	2017	County-Level Condensate Production from natural gas wells (B	0	HPDI_2016	0	HPDI_2016

Step 2 – The User can edit the yellow-shaded cells.

If data edits were made, then the User will need to go back to the Tool and click on the “Import/Export Data...” button to initiate importing the edited data file. After clicking, the Import/Export form will appear. The User will need to:

- Step 1 - Click on the “Import” tab
- Step 2 - Click the “Select File” button
- Step 3 – Map to the location of the edited data, and click “OK”
- Step 4 – Click on the “Import from Excel” button

The screenshot shows the 'Import/Export Data' window with the 'Import' tab selected. The form includes a 'Close Form' button, an 'Export' button, and an 'Import' button. Below the 'Import' button, there is a text field for the file path: 'C:\WORK\OIL\_GAS\RE\_ENGINEERING\ITERATION\_009\_2014\_NEI'. There are two buttons at the bottom: 'Import From Excel' and 'Select File'. Annotations with arrows point to these elements:

- Step 1 – Click on the “Import” tab.
- Step 2 – Click on the “Select File” button
- Step 3 – Map to the location of the edited data
- Step 4 – Click on the “Import from Excel” button

The edited data is now imported into the Tool.

## Nonpoint Oil and Gas Emissions Estimation Tool

- 16) **Step 6 – View/Edit Basin Factors.** Click the “Step 6 – View/Edit Basin Factors” tab to continue. In Step 6, the User can view and edit the basin factor data that EPA has compiled for the geographic area and source categories selected.

**Oil and Gas Tool: Production Activities - Dashboard View**

Back to Home Page    Reset All Selections/Go to Step 1    EXIT TOOL

**Oil and Gas Production Sources**

Please click on the source category below to view/edit the basin factors.

Please click on the source category below to view/edit the gas composition factors.

**Step 6 – Pick a Source Category Basin Factor or Gas Composition dataset to view/edit**

Artificial Lifts	Dehydrators	Liquids Unloading	Associated Gas	Gas-Actuated Pumps
Associated Gas	Fugitives	Loading Operations	Condensate Tank	Liquids Unloading
CBM Dewatering Pumps	Gas-Actuated Pumps	Pneumatic Devices	Crude Oil Tank	Loading Operations
Condensate Tank	Heaters	Produced Water	Dehydrators	Pneumatic Devices
Crude Oil Tank	Lateral/Gathering Compressors	Wellhead Compressors	Fugitives	Produced Water

In the Basin Factors form, the User can view/edit the data. If the User updates values for one county in a basin, then all other counties in the basin and state can be updated by clicking on the “Click to apply these values to all other counties in the same basin for the state.” button.

**Crude Oil Tanks Basin Factors Form**

State Abbreviation: AR  
 State and County FIPS Code: 05023  
 County Name: Cleburne  
 Basin Name: Arkoma Basin

The User can filter for specific basins.  
 Filter for this Basin only    Remove Basin Filter

When finished, click here

If new values are entered, please enter a reference.  
 Import/Export Data...

Click to apply these values to all other counties in the same basin for this state.

	Current Value	Current Value Reference	EPA Default Value	EPA Default Value Reference	2014 Value	2014 Value Reference
Crude Oil Fraction directed to Tanks	1	CENSARA_STUDY_2012	1	CENSARA_STUDY_2012_AVERAGE	1	CENSARA_STUDY_2012
Fraction of Oil Tanks with Flares	0	EPA_2015d	0	EPA_2015d	0	CENSARA_STUDY_2012
Average VOCs Loss (lb VOCs/BBL Crude Oil)	2.244627	CENSARA_STUDY_2012	1.015	VERAGE	2.244	CENSARA_STUDY_2012
Flaring Capture Efficiency (%)	100	CENSARA_STUDY_2012	100	VERAGE	100	CENSARA_STUDY_2012
Flaring Control Efficiency (%)	98	CENSARA_STUDY_2012	98	CENSARA_STUDY_2012_AVERAGE	98	CENSARA_STUDY_2012
Gas Venting Rate (MCF gas/BBL Crude Oil)	2.973009E-02	CENSARA_STUDY_2012	0.0148	CENSARA_STUDY_2012_AVERAGE	2.973009E-02	CENSARA_STUDY_2012

EPA default values cannot be edited.

Values from the 2014 Tool. Values here cannot be edited.

When finished, click here

Similarly, the User can view/edit the gas composition data for select categories.

- 17) **Step 7 – View/Edit Emission Factors.** Click the “Step 7 – View/Edit Emission Factors” tab to continue. In Step 7, the User can view or edit the emission factors that are used to generate the emission estimates for the source categories selected.

## Nonpoint Oil and Gas Emissions Estimation Tool

**Oil and Gas Tool: Production Activities - Dashboard View**

Back to Home Page    Reset All Selections/Go to Step 1    EXIT TOOL

Step 1 - Select Geographic Level    Step 2 - Select Specific Geographic Location    Step 3 - Select Source Category    Step 4 - Select Emission Factor Dataset    Step 5 - Select Emission Factor    Step 6 - View/Edit Basin Factors    **Step 7 - View/Edit Emission Factors**    Step 8 - Point Source Activity Adjustment

Please select the emission factor source category you would like to view/edit.

**Oil and Gas Production Sources - Emission Factors**

Please click on a Source Category below to view/edit emission factors.

Artificial Lifts    Crude Oil Tanks    Lateral/Gathering Compressors  
 Associated Gas    Dehydrators    Liquids Unloading  
 CBM Dewatering Pump Engines    Fugitives    Wellhead Compressors  
 Condensate Tanks    Heaters

Note: there are no emission factors to review for Gas-Actuated Pumps, Loading Operations, Pneumatic Devices, and Produced Water

Once a Source Category has been selected, the User can view or edit the emission factors. Remember to update the reference field (EMISSION\_FACTOR\_SOURCE) for any updated emission factors.

Geographic and Source Selections    FORM\_EF\_WELLHEAD\_COMPRESSORS

**WELLHEAD COMPRESSORS EMISSION FACTORS FORM**

ST	BASIN	ATTAINMENT	SOURCE_CATEGORY	SCC	SCC_SHORTENED	POLLUTANT_DESCRIPTION	POLLUTANT	EMISSION_FACTOR	EN	EMIS	EMIS
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	Polycyclic Aromatic Hydroca	250	4.862483E-04	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	Regulene dichloride	78875	1.618409E-04	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	SO2	100425	1.988539E-04	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.133687E-03	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.405841E-04	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	3.494457E-03	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	3.069897E-03	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	3.494457E-03	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	8.962939E-05	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	0.4354464	G	HP-HR	EPA_20
AR	Illinois Basin	ATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	9.72497E-04	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.815887E-02	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.823144E-02	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	7.039717E-03	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	1.433344E-05	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.97555E-03	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	399.1592	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	1.280988	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	2.202633E-04	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	1.611152E-04	G	HP-HR	EPA_20
AR	Illinois Basin	NONATTAINMENT	WELLHEAD COMPRESSORS	2310021102	On-Shore Gas Productic	1,2,2-	79345	1.760347E-04	G	HP-HR	EPA_20

These emission factors can be edited. If changes are made, please update the reference.

Emission Factors are presented at the state, basin, and attainment status level.

When finished, click here

## Nonpoint Oil and Gas Emissions Estimation Tool

- 18) **Step 8 – Point Source Activity Adjustments.** Click the “Step 8 – Point Source Activity Adjustments” tab to continue. After the activity data, basin factors, and emission factors have been reviewed and/or updated, the User may enter point source activity adjustments to account for emissions that are to be reported to the point sources emissions inventory. If the User does not have any point source activity adjustments, then they will need to click the “When finished, click here to complete this step.” button. A message box will appear instructing the User to proceed to Step 9.

Please click on a Source Category below to view/edit activity data for point sources adjustments.

Artificial Lifts	Dehydrators	Liquids Unloading
Associated Gas	Fugitives	Loading Operations
CBM Dewatering Pump Engines	Gas-Actuated Pumps	Pneumatic Devices
Condensate Tanks	Heaters	Produced Water
Crude Oil Tanks	Lateral/Gathering Compressors	Wellhead Compressors

If you created point source activity data adjustments and saved them for later use, please click on a Source Category below to populate

Artificial Lifts	Dehydrators	Liquids Unloading
Associated Gas	Fugitives	Loading Operations
CBM Dewatering Pump Engines	Gas-Actuated Pumps	Pneumatic Devices
Condensate Tanks	Heaters	Produced Water
Crude Oil Tanks	Lateral/Gathering Compressors	Wellhead Compressors

Clear all point source activity holding tables

Nonpoint Source SCCs and Point Source SCCs Crosswalk

When finished, click here to proceed to Step 9.

Select a Source Category to make point source activity adjustments

Select a Source Category to apply saved point source activity adjustments

Users can refer to this point/nonpoint crosswalk

### **Nonpoint Oil and Gas Emissions Estimation Tool**

Currently, ALL point source activity adjustments (e.g. county-level point source well counts, county-level point source barrels of oil produced, etc.) are defaulted to zero (i.e., no point source activity adjustments).

**HEATERS POINT SOURCE ACTIVITY ADJUSTMENT FORM**

State abbreviation:

State and County FIPs Code:

County name:

Year:

**Point Source Well Counts**

Oil Wells	Gas Wells	CBM Wells
0	0	0

Enter the point sources activity data.

When finished, click this button.

When finished, click here

**It is encouraged that point source activity adjustments have priority over point source emission adjustments. Additionally, Users should pay careful attention to ensure that the point source activity data is entered in the same units as the nonpoint activity data.** Users should refer to the “Nonpoint Source SCCs and Point Source SCCs Crosswalk” button to identify point source SCCs. After any point source activity adjustments have been made, proceed to Step 9.

- 19) Step 9 – Point Source Emission Adjustments. Click the “Step 9 – Point Source Emission Adjustments” tab to continue. In Step 9, the User can make point source emission adjustments directly in the emission tables. Select a Source Category to open. If a User has no point source emissions adjustments, they may click on the “When finished, click here to complete this step” button.

## Nonpoint Oil and Gas Emissions Estimation Tool

Sections/Go to Step 1 EXIT TOOL

### Production Sources - Point Source Emission Adjustments

Please click on a Source Category below to view/edit calculated emission records for point sources adjustments.

Select a Source Category to make point source emissions adjustments

When finished, click here to proceed to Step 10.

When finished, click here to complete this step.

Artificial Lifts	Dehydrators	Liquids Unloading
Associated Gas	Fugitives	Loading Operations
CBM Dewatering Pump Engines	Gas-Actuated Pumps	Pneumatic Devices
Condensate Tanks	Heaters	Produced Water
Crude Oil Tanks	Lateral/Gathering Compressors	Wellhead Compressors

If you created point source emissions data adjustments and saved them for later use, please click on a Source Category below to populate

Select a Source Category to apply saved point source emissions adjustments

Artificial Lifts	Dehydrators	Liquids Unloading
Associated Gas	Fugitives	Loading Operations
CBM Dewatering Pump Engines	Gas-Actuated Pumps	Pneumatic Devices
Condensate Tanks	Heaters	Produced Water
Crude Oil Tanks	Lateral/Gathering Compressors	Wellhead Compressors

Clear all point source emissions holding tables

## Nonpoint Oil and Gas Emissions Estimation Tool

Point source emission estimates are to be entered in the “POINT\_EMISSIONS\_TPY” field. **It is important to note that if point source activity adjustments were made in Step 8, then point source emission adjustments should NOT be made in these tables for overlapping SCCs. Also, point source emission adjustments need to be entered as tons per year (TPY).**

Geographic and Source Selections FORM\_EMISSIONS\_WELLHEAD\_COMPRESSORS

WELLHEAD COMPRESSORS POINT SOURCE EMISSIONS FORM

When finished, click here to finalize the emissions.

When finished, click here

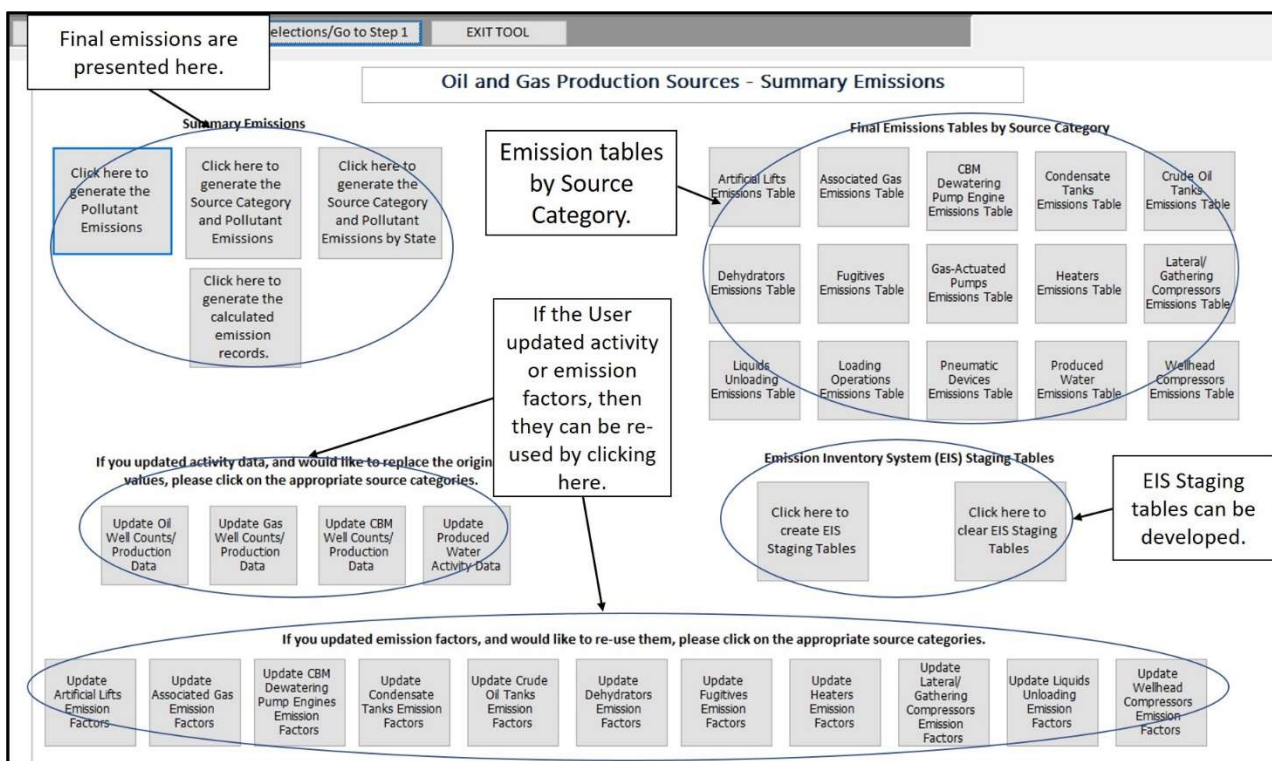
STATE	STATE_A	COUNTY_NA	SCC	SOURCE_CATEGORY	POLLUTANT	ACTIVITY_TPY	POINT_EMISSIONS_TPY	
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	75003	Ethyl	84556E-04	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	75014	Vinyl	63363E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	75070	Aceta	0.5966251	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	75092	Methy	27333E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	75343	Ethyl	84253E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	78875	Propylene Dichloride	1.919763E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	79005	1,1,2-Trichloroethane	2.269459E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	79345	1,1,2,2-Tetrachloroethane	2.854666E-03	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	91203	Naphthalene	5.309679E-05	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES			1.512973E-02	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES			115.5124	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		Monoxide	35.00402	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		Dioxide	10165.09	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		Oxide	1.935393E-02	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		n Oxides	78.27121	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		Primary (Filt + Cond)	0.9229071	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		Primary (Filt + Cond)	0.9229071	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES		oxide	5.433702E-02	0
05023	AR	Cleburne	2310021202	WELLHEAD COMPRESSOR ENGINES	VOC	Volatile Organic Compounds	8.417548	0

Users can enter point source emission adjustments

After point source emission adjustments are made (if applicable), then the User should proceed to Step 10.

- 20) **Step 10 – Final Emissions.** Click the “Step 10 – Final Emissions” tab to continue. In Step 10, the User can review the final emissions; update county-level activity data, emission factors, and/or basin factors they provided in Steps 5 through 7; or generate the Emission Inventory System (EIS) data tables.

## Nonpoint Oil and Gas Emissions Estimation Tool



## Nonpoint Oil and Gas Emissions Estimation Tool

### Summary screen (continued)

**Oil and Gas Production Sources - Summary Emissions**

If you updated gas composition data basin factors, and would like to re-use them, please click on the appropriate source categories.

Update Associated Gas Composition Data Basin Factors	Update Condensate Tanks Gas Composition Data Basin Factors	Update Crude Oil Tanks Gas Composition Data Basin Factors	Update Dehydrators Gas Composition Data Basin Factors	Update Fugitives Gas Composition Data Basin Factors
Update Gas-Actuated Pumps Gas Composition Data Basin Factors	Update Liquids Unloading Gas Composition Data Basin Factors	Update Loading Operations Gas Composition Data Basin Factors	Update Pneumatic Devices Gas Composition Data Basin Factors	Update Produced Water Gas Composition Data Basin Factors

If the User updated Basin Factors or gas composition data, then they can be saved and re-used by clicking here.

If you updated basin factors, and would like to re-use them, please click on the appropriate source categories.

Update Artificial Lifts Basin Factors	Update Associated Gas Basin Factors	Update CBM Dewatering Pump Engine Basin Factors	Update Condensate Tanks Basin Factors	Update Crude Oil Tanks Basin Factors
Update Dehydrators Basin Factors	Update Fugitives Basin Factors	Update Gas-Actuated Pumps Basin Factors	Update Heaters Basin Factors	Update Lateral/Gathering Compressors Basin Factors
Update Liquids Unloading Basin Factors	Update Loading Operations Basin Factors	Update Pneumatic Devices Basin Factors	Update Produced Water Basin Factors	Update Wellhead Compressors Basin Factors

### Summary screen (continued)

**Oil and Gas Production Sources - Summary Emissions**

If you made point source activity adjustments, and would like to re-use them, please click on the appropriate source categories.

Save Artificial Lifts point source activity adjustments	Save Associated Gas point source activity adjustments	Save CBM Dewatering Pump point source activity adjustments	Save Condensate Tanks point source activity adjustments	Save Crude Oil Tanks point source activity adjustments
Save Dehydrators point source activity adjustments	Save Fugitives point source activity adjustments	Save Gas-Actuated Pumps point source activity adjustments	Save Heaters point source activity adjustments	Save Lateral/Gathering Compressors point source activity adjustments
Save Liquids Unloading point source activity adjustments	Save Loading Operations point source activity adjustments	Save Pneumatic Devices point source activity adjustments	Save Produced Water point source activity adjustments	Save Wellhead Compressors point source activity adjustments

If the User created point source activity data and/or emission adjustments, then they can be re-used by clicking here.

If you made point source emission adjustments, and would like to re-use them, please click on the appropriate source categories.

Save Artificial Lifts point source emissions adjustments	Save Associated Gas point source emissions adjustments	Save CBM Dewatering Pump point source emissions adjustments	Save Condensate Tanks point source emissions adjustments	Save Crude Oil Tanks point source emissions adjustments
Save Dehydrators point source emissions adjustments	Save Fugitives point source emissions adjustments	Save Gas-Actuated Pumps point source emissions adjustments	Save Heaters point source emissions adjustments	Save Lateral/Gathering Compressors point source emissions adjustments
Save Liquids Unloading point source emissions adjustments	Save Loading Operations point source emissions adjustments	Save Pneumatic Devices point source emissions adjustments	Save Produced Water point source emissions adjustments	Save Wellhead Compressors point source emissions adjustments

## Nonpoint Oil and Gas Emissions Estimation Tool

Additional notes:

- 1) In the EIS Staging Tables, the ControlApproach, ControlMeasure, ControlPollutant, Emissions, EmissionsProcess, Location, and ReportingPeriod are populated.
- 2) EPA's EIS Nonpoint Bridge Tool (included in the .zip file) can be used to generate the .xml file needed for EIS upload.
- 3) If the User wishes to reset the tool, and regenerate the emissions, the following steps are recommended:
  - a. Click on the "Reset All Selections/Go to Step 1" button at the top of the Dashboard.
  - b. Compact and Repair the database.

**Oil and Gas Tool: Production Activities - Dashboard View**

Back to Home Page   Reset All Selections/Go to Step 1   EXIT TOOL

To exit the Tool, click here.

Step 1 - Select Geographic Level   Step 2 - Select Specific Geographic Location   Step 3 - Select Source Category Level   Step 4 - Select Specific Source Category   Step 5 - View/Edit Co  
Factors   Step 6 - Point Source Activity Adjustments   Step 7 - Point Source Emission Adjustments   Step 8 - Point Source Activity Adjustments   Step 9 - Point Source Emission Adjustments   Step 10 - Final Emissions

To return to the Home page, click here.

To reset the Tool, click here.

**Oil and Gas Production Sources - Summary Emissions**

**Summary Emissions**

Click here to generate the Pollutant Emissions

Click here to generate the Source Category and Pollutant Emissions

Click here to generate the Source Category and Pollutant Emissions by State

Click here to generate the calculated emission records.

**Final Emissions Tables by Source Category**

Artificial Lifts Emissions Table	Associated Gas Emissions Table	CBM Dewatering Pump Engine Emissions Table	Condensate Tanks Emissions Table	Crude Oil Tanks Emissions Table
Dehydrators Emissions Table	Fugitives Emissions Table	Gas-Actuated Pumps Emissions Table	Heaters Emissions Table	Lateral/Gathering Compressors Emissions Table
Liquids Unloading Emissions Table	Loading Operations Emissions Table	Pneumatic Devices Emissions Table	Produced Water Emissions Table	Wellhead Compressors Emissions Table

## Nonpoint Oil and Gas Emissions Estimation Tool

- 4) References cited for the original data in the Tool are found in the "Master References" tab.

The screenshot displays the 'Oil and Gas Tool: Production Activities - Dashboard View'. At the top, there are navigation buttons: 'Back to Home Page', 'Reset All Selections/Go to Step 1', and 'EXIT TOOL'. Below these are step indicators for Steps 1 through 10, with 'Master References' being the active tab. A callout box with the text 'References cited in the Tool for the original data are here.' points to a table of references. The table has two columns: 'FIELD\_REFERENCE' and 'DESCRIPTION'. The references listed include data from Alaska, Alabama, and California oil and gas commissions, the API Compendium, CENRAP, CENSARA, and the Energy Information Administration (EIA).

FIELD_REFERENCE	DESCRIPTION
AK_OGC_2012	Alaska Oil and Gas Commission data
AK_OGC_2013_RIGDATA	Alaska Oil and Gas Commission data from RIGDATA
AL_OGC_2013_RIGDATA	Alabama Oil and Gas Commission data from RIGDATA
API_2009a	API Compendium (8/2009), Table 4-11
API_2009b	API Compendium (8/2009), Table 4-11
AR_DEQ_2013	Arkansas Oil and Gas Commission well completion reports
CA_OGC_2013	California Oil and Gas Commission data
CA_OGC_2013_RIGDATA	California Oil and Gas Commission drilling data scaled to California state totals from RIGDATA
CENRAP_2008	ENVIRON. Recommendations for Improvements to the CENRAP STATES' OIL AND GAS EMISSIONS INVENTORIES, November 2008
CENSARA_STUDY_2012	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 201
CENSARA_STUDY_2012_AVERAGE	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 201
CENSARA_STUDY_2012_EXTENSION	ENVIRON International Corporation. Oil and Gas Emission Inventory Enhancement Project for CenSARA States. December 21, 201
CLIMATE_REGISTRY_2010	The Climate Registry Oil and Gas Production Annex II to the General Reporting Protocol, 2010 - Table 17.5
EIA_2012	Energy Information Administration (EIA). 2012. Accessed online at: <a href="http://www.eia.gov/">http://www.eia.gov/</a>

**APPENDIX C – US OIL AND GAS BASINS (FOUND IN THE “NATIONAL OIL AND GAS TOOL  
REPORT APPENDIX C - DATA ELEMENT DICTIONARY.XLSX” FILE)**

**APPENDIX D – DATA ELEMENT DICTIONARY (FOUND IN THE “NATIONAL OIL AND GAS TOOL  
REPORT APPENDIX D – US OIL AND GAS BASINS.XLSX” FILE)**

## AGRICULTURAL PESTICIDES

### A. Source Category Description

Pesticides are substances used to control nuisance species and can be classified by targeted pest group: weeds (herbicides), insects (insecticides), fungi (fungicides), and rodents (rodenticides). They can be further described by their chemical characteristics: synthetics, non-synthetics (petroleum products), and inorganics. Different pesticides are made through various combinations of the pest-killing material, also called the active ingredient, and various solvents (which serve as carriers for the active ingredient). Both types of ingredients contain volatile organic compounds (VOC) that may be emitted to the air during application or after application as a result of evaporation.<sup>1</sup>

Approximately 68 to 75 percent of pesticides used in the United States are applied to agricultural lands, both cropland and pasture. Agricultural pesticides continue to be a cost-effective means of controlling weeds, insects, and other threats to the quality and yield of food production. Since application rates for a particular pesticide may vary from region to region, the regional application rates should be considered when estimating potential VOC emissions. In 2014, agricultural pesticides resulted in approximately 205,448.4 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461850000	Solvent Utilization	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural	All Processes

### B. Overview of Calculations

The USGS provides county-level estimates of pesticide application, in its report “Preliminary Estimates of Annual Agricultural Pesticide Use for Counties of the Conterminous United States, 2013.”<sup>2</sup> This report provides information about the total application of each active ingredient in a pesticide product (e.g. 2,4-D, atrazine, captan). There are often many different pesticide products with the same active ingredient. For example, the California Department of Pesticide Regulation’s (CA DPR) database<sup>3</sup> lists 49 registered pesticide products with atrazine as the active ingredient, each with slightly different formulations, including different proportions of active ingredient and solvents. The CA DPR database includes information on the mass fraction of active ingredient in each pesticide product. EPA uses this information to calculate an average VOC emissions factor for each active ingredient listed in the CA DPR database. This VOC emissions factor is multiplied by the amount of active ingredient applied in each county, from the USGS report, to estimate VOC emissions in each county. For active ingredients not in the CA DPR database, a weighted emissions factor is calculated by weighting the emissions factors from the CA DPR database with total pounds of active ingredient reported in the USGS report. HAP emissions are calculated by multiplying the total pounds of active ingredients applied in each county by an emissions factor. Sources of data and calculations for the total pounds of active ingredients applied per pesticide are discussed in section C. Emissions factors calculations are discussed in section E. The estimation of emissions from agricultural pesticides is discussed in section G.

### C. Activity Data

The activity for pesticide application is the pounds of active ingredient applied per pesticide at the county level for the year 2013, from the USGS report “Preliminary Estimates of Annual Agricultural Pesticide Use for Counties of the Conterminous United States, 2013,”<sup>2</sup> which gives county-level pesticide data in terms of kg of active ingredient applied. The report estimates preliminary annual county-level pesticide use for 387 herbicides, insecticides, and fungicides applied to agricultural crops grown in the conterminous United States during 2013. For all states except California, pesticide-use data are compiled from proprietary surveys of farm operations located within U.S. Department of Agriculture Crop Reporting Districts (CRDs). Surveyed pesticide-use data are used in conjunction with county annual harvested-crop acres reported by the U.S. Department of Agriculture 2012 Censuses of Agriculture and the 2013 County Agricultural Production Survey to calculate use rates per harvested-crop acre, or an “estimated pesticide use” (EPest) rate, for each crop by year. County-use estimates are then calculated by USGS by multiplying EPest rates by harvested-crop acres for each pesticide crop combination. Use estimates for California in

the USGS data are obtained from annual CA DPR Pesticide Use Reports.

The USGS report calculates both EPest-low and EPest-high rates. The EPest-high rates are used here to estimate VOC emissions. Both methods incorporated surveyed and extrapolated rates to estimate pesticide use for counties, but EPest-low and EPest-high estimations differ in how situations are treated when a CRD was surveyed and pesticide use was not reported for a particular pesticide-by-crop combination. If use of a pesticide on a crop is not reported in a surveyed CRD, EPest-low reports zero use in the CRD for that pesticide-by-crop combination. EPest-high, however, treats the unreported use for that pesticide-by-crop combination in the CRD as unsurveyed, and pesticide-by-crop use rates from neighboring CRDs and, in some cases, CRDs within the same Farm Resources Region are used to calculate the pesticide-by-crop EPest-high rate for that CRD.

Due to data limitations, the USGS report does not contain active ingredient usages for Alaska and Hawaii. However, the Census of Agriculture contains acres treated with pesticide by county for Alaska and Hawaii and these values are used to estimate emissions.

#### D. Allocation Procedure

The activity data are reported at the county level and do not need to be allocated.

#### E. Emissions Factors

The VOC emissions factors are derived for each active ingredient based on the pesticide profiles database maintained by the CA DPR.<sup>3</sup> This database contains the chemical formulation for pesticide products registered in the State of California and provides key inputs for the development of VOC emissions factors, including the mass fraction of the active ingredient and the emission potential (EP) of registered pesticide products. The EP value represents the VOC content of the pesticide product and it is determined empirically through thermogravimetric analysis. Since the CA DPR database lists both agricultural and non-agricultural pesticide products, it is necessary to screen out entries that were likely formulated as a consumer product. Pesticide products that contained terms suggesting non-agricultural applications are excluded. Terms used to screen out likely consumer products are listed in Table 1.

**Table 1. Terms Used to Screen Out Consumer Products**

ALGAE	DEODORIZING	GERM	MRSA	STAIN
ANT	DETERGENT	HAMSTER	ORNAMENTAL	SWIM
BATHROOM	DISHWASHER	HOME	POND	TICK
BEDBUG	DISINFECT	HORNET	POTTY	TURF
BEE	DOG	HORSE	PRESCRIPTION	WASP
CAT	DRAIN	HOUSE	RAT	WIPES
CATTLE	EQUINE	INDOOR	ROACH	YARD
CLEANER	FLEA	KLEEN	RODENTICIDE	
DECK	FLY	LANDSCAPE	ROOF	
DEGREASER	FOGGER	LAWN	SANI	
DEODORIZER	GERBIL	MOUSE	SPA	

Each record in the CA DPR database is for a specific pesticide product, and provides the product name, primary active ingredient, mass percent of active ingredient, emission potential (EP), registration number, and method used to estimate the EP. The pesticide-specific EP of reactive organic gases (i.e., the mass percentage of product that contributes to VOC emissions) and the mass percent of active ingredient are used to calculate pesticide-specific VOC emissions factors.

The CA DPR emission potential database<sup>3</sup> provides the pesticide-specific emissions potential of reactive organic

gases (i.e., the mass percentage of each pesticide product that contributes to VOC emissions) and the mass percent of active ingredient. To determine the total amount of pesticide product applied (i.e. both the active ingredient and the solvent) the amount of active ingredient applied (from USGS data)<sup>2</sup> is divided by the mass percent of active ingredient, which is divided by 100 to convert from percent to fraction.

$$TP_{pest,US} = \frac{AI_{pest,US}}{\frac{MP_{pest,US}}{100}} \quad (1)$$

Where:

- $TP_{pest,US}$  = Total pesticide applied for each active ingredient in the United States, in lbs.
- $AI_{pest,US}$  = Total active ingredient applied of each pesticide type in the United States, in lbs.
- $MP_{pest,US}$  = Average mass percent of active ingredient in each pesticide type in the United States, in percent

Next, the total national-level VOC emissions from each pesticide type are estimated by multiplying the total pesticide applied by the pesticide-specific emissions potential of reactive organic gases (i.e., the mass percentage of each pesticide that contributes to VOC emissions), from the CA DPR database.<sup>3</sup>

$$E_{VOC,US,pest} = TP_{pest,US} \times \frac{EP_{rog,pest}}{100} \quad (2)$$

Where:

- $E_{VOC,US,pest}$  = Total national-level VOC emissions for each pesticide type, in lbs.
- $TP_{pest,US}$  = Total pesticide applied of each pesticide type in the United States, in lbs.
- $EP_{rog,pest}$  = Emissions potential of reactive organic gases for each pesticide, expressed as % of pesticide mass

The VOC emissions factor for each pesticide type is calculated by dividing the total national-level VOC emissions for each pesticide type by the total active ingredient applied for each pesticide type.

$$EF_{pest} = \frac{E_{VOC,US,pest}}{AI_{pest,US}} \quad (3)$$

Where:

- $EF_{pest}$  = Pesticide-specific emissions factor, in pounds VOC / pound active ingredient
- $E_{VOC,US,pest}$  = Total national-level VOC emissions for each pesticide type, in lbs.
- $AI_{pest,US}$  = Total active ingredient applied of each pesticide type in the United States, in lbs.

For active ingredients not in the CA DPR database, a weighted average emissions factor ( $EF_{avg}$ ) is calculated. This weighted average is estimated by weighting the emissions factors from the CA DPR database using the total pounds of active ingredient reported in the USGS report “Preliminary Estimates of Annual Agricultural Pesticide Use for Counties of the Conterminous United States, 2013.”<sup>2</sup> A crosswalk between compound name in the USGS database and the chemical name in the CA DPR database is provided in Table 4. Note that any pesticide compound from the USGS database that is not in the CA DPR data are marked with the word “AVERAGE,” to denote that the weighted average VOC emissions factors of 0.4 pounds of VOC per pound of active ingredient is used to estimate VOC emissions for the application of that pesticide. The pesticide-specific VOC emissions factors for all pesticides from the CA DPR database are shown in Table 5.

The emissions factor is calculated for these active ingredients based on calculating a weighted average emissions factor for all active ingredients. The weights are determined by dividing the active ingredient applied for each pesticide type by the total active ingredients applied for all pesticides types. These weights are multiplied by the emissions factor for each pesticide (calculated in step 3), and then summed to determine the weighted average emissions factor.

$$EF_{avg} = \sum_{pest=1}^{PEST} \frac{AI_{pest,US}}{\sum_{pest=1}^{PEST} AI_{pest,US}} \times EF_{pest} \quad (4)$$

Where:

$EF_{avg}$  = Weighted average emissions factor, in pounds VOC / pound active ingredient  
 $AI_{pest,US}$  = Total active ingredient applied of each pesticide type in the United States, in lbs.  
 $EF_{pest}$  = Pesticide-specific emissions factor, in pounds VOC / pound active ingredient

The HAP emissions factors are from EIIIP and are based on vapor pressure of the active ingredient.<sup>1</sup> Compounds with a vapor pressure between  $1 \times 10^{-4}$  and  $1 \times 10^{-6}$  mm Hg at 20°C to 25°C have an emissions factor of 700 lbs./ton (or 0.35 lbs./lb.). Compounds with a vapor pressure greater than  $1 \times 10^{-4}$  mm Hg at 20°C to 25°C have an emissions factor of 1,160 lbs./ton (or 0.58 lbs./lb.). The subset of HAPs is extracted from the list of active ingredients and is shown in Table 2 along with the HAP emissions factors. **If the calculated emissions factor for any HAP is greater than the VOC emissions factor for that active ingredient, calculated in step 3 of section B, then the HAP emissions factor is set equal to the VOC emissions factor.**

**Table 2. HAP Emissions Factors**

Compound	Pollutant Code	Vapor Pressure (mm Hg at 20°C to 25°C)	Emissions Factor (lbs. per lb. active ingredient)	Source
2,4-D	94757	$8 \times 10^{-6}$	0.35	Reference 1, Tables 9.4-2 and 9.4-4
CAPTAN	133062	$8 \times 10^{-8}$	0.1441	Set equal to VOC emissions factor calculated from the CA DPR. See Table 4 of this document.
CARBARYL	63252	$1.2 \times 10^{-6}$	0.3208	Set equal to VOC emissions factor calculated from the CA DPR. See Table 4 of this document.
METHYL BROMIDE	74839	1,420	0.58	Vapor pressure: Reference 4 Emissions factor: Reference <b>Error! Bookmark not defined.</b> , Table 9.4-4
METHYL IODIDE	74884	400	0.58	Vapor pressure: Reference 4 Emissions factor: Reference 1, Table 9.4-4
PARATHION	56382	$5 \times 10^{-6}$	0.35	Reference <b>Error! Bookmark not defined.</b> , Tables 9.4-2 and 9.4-4
TRIFLURALIN	1582098	$1.1 \times 10^{-4}$	0.58	Reference <b>Error! Bookmark not defined.</b> , Tables 9.4-2 and 9.4-4

For Alaska and Hawaii, data from the conterminous United States is used to develop average emissions factors by pollutant in terms of emissions per acre treated with pesticides. This is calculated by summing the total emissions by pollutant for the conterminous United States and dividing by the total acres treated in the conterminous United States.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

VOC and HAP emissions are calculated by multiplying the amount of active ingredient applied in each county, from the USGS database, by the appropriate emissions factor. The emissions factor for VOC is calculated using equations 1-4. The emissions factors for the HAPs are listed in Table 2.

The VOC emissions are calculated by multiplying the active ingredients applied in each county per year by the corresponding emissions factor.

$$E_{VOC,c} = \sum AI_{pest,c} \times EF_{pest} \times \frac{1 \text{ ton}}{2000 \text{ lb}} \quad (5)$$

Where:

$E_{VOC,c}$  = Annual emissions of VOC from pesticide active ingredient applications in county  $c$ , in tons  
 $AI_{pest,c}$  = Active ingredient of each pesticide type applied in county  $c$ , in pounds  
 $EF_{pest}$  = Pesticide-specific emissions factor, in pounds VOC / pound active ingredient

Note that if the active ingredient ( $AI_{pest}$ ) is included in the CA DPR database, then the pesticide-specific emissions factor is used ( $EF_{pest}$ ); for all other active ingredients, the weighted average emissions factor is used ( $EF_{avg}$ ).

The HAP emissions are calculated by multiplying the active ingredients applied in each county per year by the corresponding emissions factor. The HAPs listed in Table 2 correspond to the active ingredients in the USGS database. For example, emissions of the HAP captan only occur from applications of the active ingredient captan. Emissions are then summed across pesticide types to estimate the total county-level emissions for each HAP.

$$E_{p,c} = \sum_{pest=1}^{PEST} AI_{pest,c} \times EF_{p,pest} \quad (6)$$

Where:

$E_{p,c}$  = Emissions of pollutant  $p$  from pesticide applications in county  $c$ , in lbs.  
 $EF_{p,pest}$  = Emissions factor for pollutant  $p$ , in pounds emissions / pound active ingredient  
 $AI_{pest,c}$  = Active ingredient of each pesticide type applied in county  $c$ , in pounds

Note that the HAP emissions factors are from the EIIP. **Error! Bookmark not defined.** **If the HAP emissions factor for a certain pesticide type exceeds the VOC emissions factor calculated for that pesticide type as calculated in equations 1 and 2, then the HAP emissions factor is set equal to the VOC emissions factor.**

For Alaska and Hawaii, emissions are estimated by multiplying the acres treated with pesticides by pollutant-specific emissions per acre emissions factors.

## H. Point Source Subtraction

Point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 lists sample calculations to determine the VOC and 2,4-D emissions from 2,4-Dichlorophenoxy Acetic Acid (2,4-D). The sample calculations show the emission calculations for the pesticide 2,4-D only. To estimate the total county-level emissions, the process would need to be repeated for each pesticide.

**Table 3. Sample calculations for VOC/HAP emissions from 2,4-D agricultural pesticide application in Autauga County, AL**

Eq. #	Equation	Values for Autauga County, AL	Result
1	$TP_{pest,US} = \frac{AI_{pest,US}}{\frac{MP_{pest,US}}{100}}$	$\frac{41,912,210 \text{ lbs } 2,4 - D \text{ active ingredient}}{\frac{4.84 \text{ mass percent}}{100}}$	865,954,752 lbs total 2,4-D pesticide applied in the United States

Eq. #	Equation	Values for Autauga County, AL	Result
2	$E_{VOC,US,pest} = TP_{pest,US} \times \frac{EP_{rog,pest}}{100}$	865,954,752 lbs total 2,4 – D pesticide $\times \frac{4.0}{100}$	34,638,190 lbs VOC emissions from 2,4-D in the United States
3	$EF_{pest} = \frac{E_{VOC,US,pest}}{AI_{pest,US}}$	$\frac{34,638,190 \text{ lbs VOC}}{41,912,210 \text{ lbs 2,4 – D active ingredient}}$	0.826 lbs. VOC/lb. 2,4-D active ingredient
4	$EF_{avg} = \sum_{pest=1}^{PEST} \frac{AI_{pest}}{\sum_{pest=1}^{PEST} AI_{pest}} \times EF_{pest}$	N/A	This calculation is not needed, as 2,4-D is included in the CA DPR database.
5	$E_{VOC,c} = \sum AI_{pest,c} \times EF_{pest} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	$8020 \text{ lbs. 2,4 – D active ingredient} \times 0.826 \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	3.31 tons VOC emissions from 2,4-D in Autauga County, AL
6	$E_{p,c} = \sum_{pest=1}^{PEST} AI_{pest,c} \times EF_{p,pest}$	$8020 \text{ lbs. 2,4 – D active ingredient} \times 0.35$	2,807 pounds 2,4-D emissions from 2,4-D in Autauga County, AL

## J. Changes from 2014 Methodology

As discussed in section C above, EPA developed an emissions estimation methodology for Alaska and Hawaii counties that is not used for the 2014 v2 NEI.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> U.S. Environmental Protection Agency. 2001. Emissions Inventory Improvement Program, Vol. 3, Ch. 9, "Pesticides - Agricultural and Nonagricultural", Section 5.1, p. 9.5-4, [https://www.epa.gov/sites/production/files/2015-08/documents/iii09\\_jun2001.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/iii09_jun2001.pdf)
- <sup>2</sup> United States Geological Survey, "Preliminary Estimates of Annual Agricultural Pesticide Use for Counties of the Conterminous United States, 2013", <https://pubs.er.usgs.gov/publication/ofr20151176>
- <sup>3</sup> Personal communication from Pam Wofford, California Department of Pesticide Regulation to Jonathan Dorn, Abt Associates, "CDPR\_Emission\_Potential\_Database\_10\_2015.xlsx", January 2016
- <sup>4</sup> U.S. Environmental Protection Agency. 2000. Health Effects Notebook for Hazardous Air Pollutants. <https://www.epa.gov/haps/health-effects-notebook-hazardous-air-pollutants>

**Table 4. Crosswalk between USGS Compound Name and CA DPR Chemical Name**

USGS Compound Name	CA DPR Compound Name
2,4-D	2,4-D
2,4-DB	2,4-DB ACID
6-BENZYLADENINE	AVERAGE
ABAMECTIN	ABAMECTIN
ACEPHATE	ACEPHATE
ACEQUINOCYL	ACEQUINOCYL
ACETAMIPRID	ACETAMIPRID
ACETOCHLOR	AVERAGE
ACIBENZOLAR	ACIBENZOLAR-S-METHYL
ACIFLUORFEN	ACIFLUORFEN, SODIUM SALT
ALACHLOR	ALACHLOR
ALDICARB	ALDICARB
ALUMINUM PHOSPHIDE	ALUMINUM PHOSPHIDE
AMECTOCTRADIN	AMETOCTRADIN
AMETRYN	AMETRYNE
AMINOPYRALID	AMINOPYRALID, TRIISOPROPANOLAMINE SALT
ASULAM	ASULAM, SODIUM SALT
ATRAZINE	ATRAZINE
AVIGLYCINE	AVERAGE
AZADIRACTIN	AZADIRACTIN
AZINPHOS-METHYL	AZINPHOS-METHYL
AZOXYSTROBIN	AZOXYSTROBIN
BACILLUS AMYLOLIQUIFACIENS	BACILLUS AMYLOLIQUEFACIENS STRAIN D747
BACILLUS CEREUS	BACILLUS CEREUS, STRAIN BP01
BACILLUS FIRMUS	BACILLUS FIRMUS (STRAIN I-1582)
BACILLUS PUMILIS	BACILLUS PUMILUS GHA 180
BACILLUS SUBTILIS	BACILLUS SUBTILIS GB03
BACILLUS THURINGIENSIS	BACILLUS THURINGIENSIS (BERLINER)
BENFLURALIN	AVERAGE
BENOMYL	BENOMYL
BENSULFURON	BENSULFURON METHYL
BENSULIDE	BENSULIDE
BENTAZONE	BENTAZON, SODIUM SALT
BIFENAZATE	BIFENAZATE
BIFENTHRIN	BIFENTHRIN
BISPYRIBAC	BISPYRIBAC-SODIUM
BOSCALID	BOSCALID
BROMACIL	BROMACIL

USGS Compound Name	CA DPR Compound Name
BROMOXYNIL	BROMOXYNIL BUTYRATE
BUPROFEZIN	BUPROFEZIN
BUTRALIN	AVERAGE
CALCIUM POLYSULFIDE	AVERAGE
CAPTAN	CAPTAN
CARBARYL	CARBARYL
CARBOPHENOTHION	CARBOPHENOTHION
CARBOXIN	CARBOXIN
CARFENTRAZONE-ETHYL	CARFENTRAZONE-ETHYL
CHINOMETHIONAT	AVERAGE
CHLORANTRANILIPROLE	CHLORANTRANILIPROLE
CHLORETHOXYFOS	AVERAGE
CHLORFENAPYR	CHLORFENAPYR
CHLORIMURON	AVERAGE
CHLORMEQUAT	CHLORMEQUAT CHLORIDE
CHLORONEB	CHLORONEB
CHLOROPICRIN	CHLOROPICRIN
CHLOROTHALONIL	CHLOROTHALONIL
CHLORPROPHAM	CHLORPROPHAM
CHLORPYRIFOS	CHLORPYRIFOS
CHLORSULFURON	CHLORSULFURON
CLETHODIM	CLETHODIM
CLODINAFOP	AVERAGE
CLOFENTEZINE	CLOFENTEZINE
CLOMAZONE	CLOMAZONE
CLOPYRALID	CLOPYRALID
CLORANSULAM-METHYL	AVERAGE
CLOTHIANIDIN	CLOTHIANIDIN
CONIOTHYRIUM MINITANS	CONIOTHYRIUM MINITANS STRAIN CON/M/91-08
COPPER	COPPER
COPPER HYDROXIDE	COPPER HYDROXIDE
COPPER OCTANOATE	COPPER OCTANOATE
COPPER OXYCHLORIDE	COPPER OXYCHLORIDE
COPPER OXYCHLORIDE S	COPPER OXYCHLORIDE SULFATE
COPPER SULF TRIBASIC	COPPER SULFATE (BASIC)
COPPER SULFATE	COPPER SULFATE (PENTAHYDRATE)
CPPU	AVERAGE
CRYOLITE	CRYOLITE
CUPROUS OXIDE	COPPER OXIDE (OUS)
CYANAMIDE	AVERAGE

USGS Compound Name	CA DPR Compound Name
CYAZOFAMID	CYAZOFAMID
CYCLANILIDE	CYCLANILIDE
CYCLOATE	CYCLOATE
CYDIA POMONELLA	AVERAGE
CYFLUFENAMID	CYFLUFENAMID
CYFLUTHRIN	CYFLUTHRIN
CYHALOFOP	CYHALOFOP-BUTYL
CYHALOTHRIN-GAMMA	AVERAGE
CYHALOTHRIN-LAMBDA	AVERAGE
CYMOXANIL	CYMOXANIL
CYPERMETHRIN	CYPERMETHRIN
CYPROCONAZOLE	AVERAGE
CYPRODINIL	CYPRODINIL
CYROMAZINE	CYROMAZINE
CYTOKININ	CYTOKININ
DAMINOZIDE	DAMINOZIDE
DAZOMET	DAZOMET
DCPA	AVERAGE
DECAN-1-OL	AVERAGE
DELTAMETHRIN	DELTAMETHRIN
DESMEDIPHAM	DESMEDIPHAM
DIAZINON	DIAZINON
DICAMBA	DICAMBA
DICHLOBENIL	DICHLOBENIL
DICHLOROPROPENE	AVERAGE
DICHLORPROP	DICHLORPROP, BUTOXYETHANOL ESTER
DICLOFOP	DICLOFOP-METHYL
DICLORAN	DICLORAN
DICLOSULAM	AVERAGE
DICOFOL	DICOFOL
DICROTOPHOS	DICROTOPHOS
DIENOCHLOR	DIENOCHLOR
DIETHATYL	DIETHATYL-ETHYL
DIFENOCONAZOLE	DIFENOCONAZOLE
DIFLUBENZURON	DIFLUBENZURON
DIFLUFENZOPYR	DIFLUBENZURON
DIMETHENAMID	DIMETHENAMID-P
DIMETHENAMID-P	DIMETHENAMID-P
DIMETHIPIN	DIMETHIPIN
DIMETHOATE	DIMETHOATE

USGS Compound Name	CA DPR Compound Name
DIMETHOMORPH	DIMETHOMORPH
DIMETHYL DISULFIDE	AVERAGE
DINOSEB	DINOSEB
DINOTEFURAN	DINOTEFURAN
DIQUAT	DIQUAT DIBROMIDE
DISULFOTON	DISULFOTON
DITHIOPYR	DITHIOPYR
DIURON	DIURON
DODINE	DODINE
EMAMECTIN	EMAMECTIN BENZOATE
ENDOSULFAN	ENDOSULFAN
ENDOTHAL	ENDOTHALL, DISODIUM SALT
EPTC	EPTC
ESFENVALERATE	ESFENVALERATE
ETHALFLURALIN	ETHALFLURALIN
ETHEPHON	ETHEPHON
ETHION	ETHION
ETHOFUMESATE	ETHOFUMESATE
ETHOPROPHOS	ETHOPROP
ETOXAZOLE	ETOXAZOLE
ETRIDIAZOLE	AVERAGE
FAMOXADONE	AVERAGE
FATTY ALCOHOLS	AVERAGE
FENAMIDONE	FENAMIDONE
FENAMIPHOS	FENAMIPHOS
FENARIMOL	FENARIMOL
FENBUCONAZOLE	FENBUCONAZOLE
FENBUTATIN OXIDE	FENBUTATIN-OXIDE
FENHEXAMID	FENHEXAMID
FENOXAPROP	FENOXAPROP-ETHYL
FENOXYCARB	FENOXYCARB
FENPROPATHRIN	FENPROPATHRIN
FENPYROXIMATE	FENPYROXIMATE
FENTIN	FENTIN HYDROXIDE
FERBAM	FERBAM
FIPRONIL	FIPRONIL
FLAZASULFURON	FLAZASULFURON
FLONICAMID	FLONICAMID
FLORASULAM	FLORASULAM
FLUAZIFOP	FLUAZIFOP-BUTYL

USGS Compound Name	CA DPR Compound Name
FLUAZINAM	FLUAZINAM
FLUBENDIAMIDE	FLUBENDIAMIDE
FLUCARBAZONE	AVERAGE
FLUDIOXONIL	FLUDIOXONIL
FLUFENACET	AVERAGE
FLUMETRALIN	FLUOMETURON
FLUMETSULAM	AVERAGE
FLUMICLORAC	FLUMICLORAC-PENTYL
FLUMIOXAZIN	FLUMIOXAZIN
FLUOMETURON	FLUOMETURON
FLUOPICOLIDE	FLUOPICOLIDE
FLUOPYRAM	FLUOPYRAM
FLUOXASTROBIN	FLUOXASTROBIN
FLURIDONE	FLURIDONE
FLUROXYPYR	FLUROXYPYR
FLUTHIACET-METHYL	AVERAGE
FLUTOLANIL	FLUTOLANIL
FLUTRIAFOL	FLUTRIAFOL
FLUVALINATE-TAU	AVERAGE
FLUXAPYROXAD	FLUXAPYROXAD
FOMESAFEN	AVERAGE
FORAMSULFURON	FORAMSULFURON
FORMETANATE	FORMETANATE HYDROCHLORIDE
FOSETYL	FOSETYL-AL
GALLEX	META-CRESOL
GAMMA AMINOBUTYRIC ACID	AVERAGE
GIBBERELIC ACID	GIBBERELLINS
GLUFOSINATE	GLUFOSINATE-AMMONIUM
GLYPHOSATE	GLYPHOSATE
HALOSULFURON	HALOSULFURON-METHYL
HARPIN PROTEIN	HARPIN PROTEIN
HEXAZINONE	HEXAZINONE
HEXYTHIAZOX	HEXYTHIAZOX
HYDRAMETHYLNON	HYDRAMETHYLNON
HYDRATED LIME	CALCIUM HYDROXIDE
HYDROGEN PEROXIDE	HYDROGEN PEROXIDE
HYMEXAZOL	AVERAGE
IBA	IBA
IMAZALIL	IMAZALIL
IMAZAMETHABENZ	IMAZAMETHABENZ

USGS Compound Name	CA DPR Compound Name
IMAZAMOX	IMAZAMOX
IMAZAPIC	IMAZAPIC
IMAZAPYR	IMAZAPYR
IMAZAQUIN	AVERAGE
IMAZETHAPYR	IMAZETHAPYR
IMAZOSULFURON	IMAZOSULFURON
IMIDACLOPRID	IMIDACLOPRID
INDAZIFLAM	INDAZIFLAM
INDOXACARB	INDOXACARB
IODOSULFURON	AVERAGE
IPCONAZOLE	IPCONAZOLE
IPRODIONE	IPRODIONE
ISOXABEN	ISOXABEN
ISOXAFLUTOLE	AVERAGE
KAOLIN CLAY	KAOLIN
KINOPRENE	KINOPRENE
KRESOXIM-METHYL	KRESOXIM-METHYL
LACTOFEN	AVERAGE
L-GLUTAMIC ACID	GLUTAMIC ACID
LINURON	LINURON
MALATHION	MALATHION
MALEIC HYDRAZIDE	MALEIC HYDRAZIDE
MANCOZEB	MANCOZEB
MANDIPROPAMID	MANDIPROPAMID
MANEB	MANEB
MCPA	MCPA
MCPB	MCPB, SODIUM SALT
MECOPROP	MECOPROP-P
MEFENOXAM	MEFENOXAM
MEPIQUAT	MEPIQUAT CHLORIDE
MESOSULFURON	MESOSULFURON-METHYL
MESOTRIONE	MESOTRIONE
METALAXYL	METALAXYL
METALDEHYDE	METALDEHYDE
METAM	METAM-SODIUM
METAM POTASSIUM	METAM-SODIUM
METCONAZOLE	METCONAZOLE
METHAMIDOPHOS	METHAMIDOPHOS
METHIDATHION	METHIDATHION
METHIOCARB	METHIOCARB

USGS Compound Name	CA DPR Compound Name
METHOMYL	METHOMYL
METHOXYFENOZIDE	METHOXYFENOZIDE
METHYL BROMIDE	METHYL BROMIDE
METHYL BROMIDE	METHYL BROMIDE
METHYL IODIDE	METHYL IODIDE
METHYL PARATHION	METHYL PARATHION
METIRAM	METIRAM
METOLACHLOR	METOLACHLOR
METOLACHLOR-S	METOLACHLOR
METRAFENONE	METRAFENONE
METRIBUZIN	METRIBUZIN
METSULFURON	METSULFURON-METHYL
MEVINPHOS	MEVINPHOS
MSMA	MSMA
MYCLOBUTANIL	MYCLOBUTANIL
MYROTHECIUM VERRUCARIA	MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS
NALED	NALED
NAPHTHYLACETAMIDE	AVERAGE
NAPHTHYLACETIC ACID	AVERAGE
NAPROPAMIDE	NAPROPAMIDE
NAPTALAM	NAPTALAM, SODIUM SALT
NEEM OIL	AVERAGE
NICOSULFURON	NICOSULFURON
NORFLURAZON	NORFLURAZON
NOSEMA LOCUSTAE CANN	NOSEMA LOCUSTAE SPORES
NOVALURON	NOVALURON
ORTHOSULFAMURON	ORTHOSULFAMURON
ORYZALIN	ORYZALIN
OXADIAZON	OXADIAZON
OXAMYL	OXAMYL
OXYDEMETON-METHYL	OXYDEMETON-METHYL
OXYFLUORFEN	OXYFLUORFEN
OXYTETRACYCLINE	OXYTETRACYCLINE HYDROCHLORIDE
PACLOBUTRAZOL	PACLOBUTRAZOL
PARAQUAT	PARAQUAT DICHLORIDE
PARATHION	PARATHION
PELARGONIC ACID	AVERAGE
PENDIMETHALIN	PENDIMETHALIN
PENOXSULAM	PENOXSULAM

USGS Compound Name	CA DPR Compound Name
PENTHIOPYRAD	PENTHIOPYRAD
PERMETHRIN	PERMETHRIN
PETROLEUM DISTILLATE	PETROLEUM DISTILLATES
PETROLEUM OIL	PETROLEUM NAPHTHENIC OILS
PHENMEDIPHAM	PHENMEDIPHAM
PHORATE	PHORATE
PHOSMET	PHOSMET
PHOSPHORIC ACID	PHOSPHORIC ACID
PICLORAM	PICLORAM
PINOXADEN	PINOXADEN
PIPERONYL BUTOXIDE	PIPERONYL BUTOXIDE
POLYHEDROSIS VIRUS	POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR
POLYOXORIM	AVERAGE
POTASSIUM BICARBONATE	POTASSIUM BICARBONATE
POTASSIUM OLEATE	AVERAGE
PRIMISULFURON	AVERAGE
PRODIAMINE	PRODIAMINE
PROFENOFOS	PROFENOFOS
PROHEXADIONE	PROHEXADIONE CALCIUM
PROMETRYN	PROMETRYN
PROPAMOCARB HCL	PROPAMOCARB HYDROCHLORIDE
PROPANIL	PROPANIL
PROPARGITE	PROPARGITE
PROPAZINE	PROPAZINE
PROPICONAZOLE	PROPICONAZOLE
PROPOXYCARBAZONE	AVERAGE
PROPYZAMIDE	PROPYZAMIDE
PROSULFURON	AVERAGE
PROTHIOCONAZOLE	PROTHIOCONAZOLE
PSEUDOMONAS FLUORESCENS	PSEUDOMONAS FLUORESCENS, STRAIN A506
PYMETROZINE	PYMETROZINE
PYRACLOSTROBIN	PYRACLOSTROBIN
PYRAFLUFEN ETHYL	PYRAFLUFEN-ETHYL
PYRASULFOTOLE	AVERAGE
PYRETHRINS	PYRETHRINS
PYRIDABEN	PYRIDABEN
PYRIMETHANIL	PYRIMETHANIL
PYRIPROXYFEN	PYRIPROXYFEN
PYRITHIOBAC-SODIUM	PYRITHIOBAC-SODIUM

USGS Compound Name	CA DPR Compound Name
PYROXASULFONE	AVERAGE
PYROXSULAM	PYROXSULAM
QUINCLORAC	QUINCLORAC
QUINOXYFEN	QUINOXYFEN
QUINTOZENE	AVERAGE
QUIZALOFOP	QUIZALOFOP-ETHYL
RIMSULFURON	RIMSULFURON
ROTENONE	ROTENONE
SABADILLA	SABADILLA ALKALOIDS
SAFLUFENACIL	SAFLUFENACIL
SETHOXYDIM	SETHOXYDIM
SILICATES	SILICA AEROGEL
SIMAZINE	SIMAZINE
SODIUM CHLORATE	SODIUM CHLORATE
SODIUM CHLORATE	SODIUM CHLORATE
SPINETORAM	SPINETORAM
SPINOSYN	SPINOSAD
SPIRODICLOFEN	SPIRODICLOFEN
SPIROMESIFEN	SPIROMESIFEN
SPIROTETRAMAT	SPIROTETRAMAT
STREPTOMYCIN	STREPTOMYCIN
SULFCARBAMIDE	AVERAGE
SULFENTRAZONE	SULFENTRAZONE
SULFOMETURON	SULFOMETURON-METHYL
SULFOSATE	AVERAGE
SULFOSULFURON	SULFOSULFURON
SULFOXAFLOX	SULFOXAFLOX
SULFUR	SULFUR
SULFURIC ACID	SULFURIC ACID
TCMTB	TCMTB
TEBUCONAZOLE	TEBUCONAZOLE
TEBUFENOZIDE	TEBUFENOZIDE
TEBUPIRIMPHOS	AVERAGE
TEBUTHIURON	TEBUTHIURON
TEFLUTHRIN	AVERAGE
TEMBOTRIONE	TEMBOTRIONE
TERBACIL	TERBACIL
TERBUFOS	AVERAGE
TETRABOROHYDRATE	AVERAGE
TETRACONAZOLE	TETRACONAZOLE

USGS Compound Name	CA DPR Compound Name
TETRATHIOCARBONATE	AVERAGE
THIABENDAZOLE	THIABENDAZOLE
THIACLOPRID	THIACLOPRID
THIAMETHOXAM	THIAMETHOXAM
THIAZOPYR	THIAZOPYR
THIDIAZURON	THIDIAZURON
THIENCARBAZONE-METHYL	AVERAGE
THIFENSULFURON	THIFENSULFURON-METHYL
THIOBENCARB	THIOBENCARB
THIODICARB	THIODICARB
THIOPHANATE-METHYL	THIOPHANATE-METHYL
THIRAM	THIRAM
TOPRAMEZONE	AVERAGE
TRALKOXYDIM	TRALKOXYDIM
TRIADIMEFON	TRIADIMEFON
TRIADIMENOL	TRIADIMENOL
TRI-ALLATE	TRIALATE
TRIASULFURON	AVERAGE
TRIBENURON METHYL	TRIBENURON-METHYL
TRIBUFOS	AVERAGE
TRICLOPYR	TRICLOPYR, BUTOXYETHYL ESTER
TRIFLOXYSTROBIN	TRIFLOXYSTROBIN
TRIFLOXYSULFURON	TRIFLOXYSULFURON-SODIUM
TRIFLUMIZOLE	TRIFLUMIZOLE
TRIFLURALIN	TRIFLURALIN
TRIFLUSULFURON	AVERAGE
TRINEXAPAC	TRINEXAPAC-ETHYL
TRITICONAZOLE	TRITICONAZOLE
UNICONAZOLE	UNICONIZOLE-P
VINCLOZOLIN	VINCLOZOLIN
ZETA-CYPERMETHRIN	AVERAGE
ZINC	ZINC CHLORIDE
ZINEB	ZINEB
ZIRAM	ZIRAM
ZOXAMIDE	AVERAGE

**Table 5. VOC Emissions Factors**

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
2,4-D	0.827
2,4-DB ACID	0.067
ABAMECTIN	15.236
ACEPHATE	0.275
ACEQUINOCYL	0.135
ACETAMIPRID	0.207
ACIBENZOLAR-S-METHYL	0.063
ACIFLUORFEN, SODIUM SALT	1.887
ALACHLOR	0.513
ALDICARB	0.064
ALUMINUM PHOSPHIDE	0.055
AMETOCTRADIN	0.041
AMETRYNE	0.024
AMINOPYRALID, TRISOPROPANOLAMINE SALT	0.160
ASULAM, SODIUM SALT	0.202
ATRAZINE	0.148
AZADIRACTIN	10.092
AZINPHOS-METHYL	0.464
AZOXYSTROBIN	0.344
BACILLUS AMYLOLIQUEFACIENS STRAIN D747	0.076
BACILLUS CEREUS, STRAIN BP01	0.106
BACILLUS FIRMUS (STRAIN I- 1582)	0.052
BACILLUS PUMILUS GHA 180	2,050.000
BACILLUS SUBTILIS GB03	190.333
BACILLUS THURINGIENSIS (BERLINER)	0.487
BENOMYL	0.074
BENSULFURON METHYL	0.031
BENSULIDE	0.553
BENTAZON, SODIUM SALT	0.053
BIFENAZATE	0.084
BIFENTHRIN	1.566
BISPYRIBAC-SODIUM	0.038
BOSCALID	0.229
BROMACIL	0.850

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
BUPROFEZIN	0.164
CALCIUM HYDROXIDE	0.003
CAPTAN	0.144
CARBARYL	0.321
CARBOPHENOTHION	0.446
CARBOXIN	0.437
CARFENTRAZONE-ETHYL	0.653
CHLORANTRANILIPROLE	0.364
CHLORFENAPYR	0.137
CHLORMEQUAT CHLORIDE	0.586
CHLORONEB	0.074
CHLOROPICRIN	1.272
CHLOROTHALONIL	0.113
CHLORPROPHAM	0.325
CHLORPYRIFOS	1.538
CHLORSULFURON	0.028
CLETHODIM	1.840
CLOFENTEZINE	0.147
CLOMAZONE	0.149
CLOPYRALID	0.050
CLOTHIANIDIN	0.153
CONIOTHYRIUM MINITANS STRAIN CON/M/91-08	0.698
COPPER	0.218
COPPER HYDROXIDE	0.060
COPPER OCTANOATE	2.198
COPPER OXIDE (OUS)	0.029
COPPER OXYCHLORIDE	0.023
COPPER OXYCHLORIDE SULFATE	0.026
COPPER SULFATE (BASIC)	0.048
COPPER SULFATE (PENTAHYDRATE)	0.062
CRYOLITE	0.025
CYAZOFAMID	0.166
CYCLANILIDE	2.468
CYCLOATE	0.507
CYFLUFENAMID	0.175
CYFLUTHRIN	1.736
CYHALOFOP-BUTYL	0.452

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
CYMOXANIL	0.044
CYPERMETHRIN	1.521
CYPRODINIL	0.049
CYROMAZINE	0.228
CYTOKININ	0.254
DAMINOZIDE	0.045
DAZOMET	1.000
DELTAMETHRIN	3.949
DESMEDIPHAM	3.668
DIAZINON	0.760
DICAMBA	0.084
DICHLOBENIL	0.434
DICLOFOP-METHYL	1.042
DICLORAN	0.087
DICOFOL	0.424
DICROTOPHOS	0.258
DIENOCHLOR	0.182
DIFENOCONAZOLE	1.120
DIFLUBENZURON	0.159
DIMETHENAMID-P	0.135
DIMETHIPIN	0.367
DIMETHOATE	0.830
DIMETHOMORPH	0.038
DINOSEB	0.455
DINOTEFURAN	0.191
DIQUAT DIBROMIDE	1.456
DISULFOTON	1.186
DITHIOPYR	0.955
DIURON	0.072
DODINE	0.049
EMAMECTIN BENZOATE	3.055
ENDOSULFAN	0.492
EPTC	0.517
ESFENVALERATE	8.919
ETHALFLURALIN	1.554
ETHEPHON	0.302
ETHION	0.397
ETHOFUMESATE	0.691

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
ETHOPROP	0.416
ETOXAZOLE	0.059
FENAMIDONE	0.101
FENAMIPHOS	1.043
FENARIMOL	1.404
FENBUCONAZOLE	0.049
FENBUTATIN-OXIDE	0.058
FENHEXAMID	0.037
FENOXAPROP-ETHYL	3.132
FENOXYCARB	0.655
FENPROPATHRIN	1.469
FENPYROXIMATE	8.721
FENTIN HYDROXIDE	0.039
FERBAM	0.045
FIPRONIL	6.463
FLAZASULFURON	0.148
FLONICAMID	0.060
FLORASULAM	0.052
FLUAZIFOP-BUTYL	1.464
FLUAZINAM	0.406
FLUBENDIAMIDE	0.102
FLUDIOXONIL	0.308
FLUMICLORAC-PENTYL	0.565
FLUMIOXAZIN	0.075
FLUOMETURON	0.046
FLUOPICOLIDE	0.136
FLUOPYRAM	0.291
FLUOXASTROBIN	0.172
FLURIDONE	0.629
FLUROXYPYR	0.279
FLUTOLANIL	0.031
FLUTRIAFOL	0.331
FLUXAPYROXAD	0.020
FORAMSULFURON	0.252
FORMETANATE HYDROCHLORIDE	0.011
FOSETYL-AL	0.049
GIBBERELLINS	2.819
GLUFOSINATE-AMMONIUM	0.442

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
GLUTAMIC ACID	0.063
GLYPHOSATE	0.159
HALOSULFURON-METHYL	0.032
HARPIN PROTEIN	1.233
HEXAZINONE	0.142
HEXYTHIAZOX	0.423
HYDRAMETHYLNON	0.614
HYDROGEN PEROXIDE	0.356
IBA	0.559
IMAZALIL	0.794
IMAZAMETHABENZ	0.504
IMAZAMOX	0.016
IMAZAPIC	0.016
IMAZAPYR	0.025
IMAZETHAPYR	0.019
IMAZOSULFURON	0.049
IMIDACLOPRID	0.305
INDAZIFLAM	0.416
INDOXACARB	0.453
IPCONAZOLE	0.122
IPRODIONE	0.203
ISOXABEN	0.103
KAOLIN	0.015
KINOPRENE	0.466
KRESOXIM-METHYL	0.034
LINURON	0.077
MALATHION	0.409
MALEIC HYDRAZIDE	0.015
MANCOZEB	0.047
MANDIPROPAMID	0.209
MANEB	0.071
MCPA	0.470
MCPB, SODIUM SALT	1.206
MECOPROP-P	0.622
MEFENOXAM	0.587
MEPIQUAT CHLORIDE	0.661
MESOSULFURON-METHYL	0.822
MESOTRIONE	0.236

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
META-CRESOL	73.605
METALAXYL	0.506
METALDEHYDE	0.691
METAM-SODIUM	0.566
METCONAZOLE	0.369
METHAMIDOPHOS	0.710
METHIDATHION	1.068
METHIOCARB	0.220
METHOMYL	0.115
METHOXYFENOZIDE	0.223
METHYL BROMIDE	1.159
METHYL IODIDE	1.212
METHYL PARATHION	0.502
METIRAM	0.110
METOLACHLOR	0.198
METRAFENONE	0.074
METRIBUZIN	0.087
METSULFURON-METHYL	0.037
MEVINPHOS	0.534
MSMA	0.315
MYCLOBUTANIL	0.451
MYROTHECIUM VERRUCARIA, DRIED FERMENTATION SOLIDS	0.127
NALED	0.494
NAPROPAMIDE	0.385
NAPTALAM, SODIUM SALT	0.588
NICOSULFURON	0.037
NORFLURAZON	0.031
NOSEMA LOCUSTAE SPORES	7.085
NOVALURON	2.273
ORTHOSULFAMURON	0.097
ORYZALIN	0.212
OXADIAZON	0.182
OXAMYL	0.721
OXYDEMETON-METHYL	0.928
OXYFLUORFEN	1.012
OXYTETRACYCLINE HYDROCHLORIDE	0.199
PACLOBUTRAZOL	0.983

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
PARAQUAT DICHLORIDE	0.311
PARATHION	0.357
PENDIMETHALIN	0.559
PENOXSULAM	0.208
PENTHIOPYRAD	0.054
PERMETHRIN	3.345
PETROLEUM DISTILLATES	1.142
PETROLEUM NAPHTHENIC OILS	0.884
PHENMEDIPHAM	3.129
PHORATE	0.448
PHOSMET	1.162
PHOSPHORIC ACID	0.434
PICLORAM	0.398
PINOXADEN	10.388
PIPERONYL BUTOXIDE	4.504
POLYHEDRAL OCCLUSION BODIES (OB'S) OF THE NUCLEAR	8.922
POTASSIUM BICARBONATE	0.027
PRODIAMINE	0.126
PROFENOFOS	0.367
PROMETRYN	0.184
PROPAMOCARB HYDROCHLORIDE	0.180
PROPANIL	0.099
PROPARGITE	0.196
PROPAZINE	0.200
PROPICONAZOLE	1.052
PROPYZAMIDE	0.055
PROTHIOCONAZOLE	0.139
PSEUDOMONAS FLUORESCENS, STRAIN A506	0.022
PYMETROZINE	0.020
PYRACLOSTROBIN	0.549
PYRAFLUFEN-ETHYL	5.343
PYRETHRINS	6.737
PYRIDABEN	0.019
PYRIMETHANIL	0.188
PYRIPROXYFEN	1.387
PYRITHIOBAC-SODIUM	0.193

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
PYROXSULAM	0.135
QUINCLORAC	0.121
QUINOXYFEN	0.060
QUIZALOFOP-ETHYL	4.121
RIMSULFURON	0.070
ROTENONE	0.808
SABADILLA ALKALOIDS	2.018
SAFLUFENACIL	0.015
SETHOXYDIM	3.751
SILICA AEROGEL	0.381
SIMAZINE	0.089
SODIUM CHLORATE	0.025
SPINETORAM	0.138
SPINOSAD	0.483
SPIRODICLOFEN	0.229
SPIROMESIFEN	0.119
SPIROTETRAMAT	0.101
STREPTOMYCIN	0.133
SULFENTRAZONE	0.128
SULFOMETURON-METHYL	0.076
SULFOSULFURON	0.027
SULFOXAFLOX	0.060
SULFUR	0.013
SULFURIC ACID	0.088
TCMTB	0.995
TEBUCONAZOLE	0.178
TEBUFENOZIDE	0.163
TEBUTHIURON	0.075
TEMBOTRIONE	0.096
TERBACIL	0.023
TETRACONAZOLE	0.492
THIABENDAZOLE	0.117
THIACLOPRID	0.119
THIAMETHOXAM	0.178
THIAZOPYR	1.756
THIDIAZURON	0.396
THIFENSULFURON-METHYL	0.049
THIOBENCARB	0.158

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
THIODICARB	0.133
THIOPHANATE-METHYL	0.118
THIRAM	0.219
TRALKOXYDIM	0.141
TRIADIMEFON	0.162
TRIADIMENOL	0.243
TRIALATE	0.573
TRIBENURON-METHYL	0.030
TRICLOPYR, BUTOXYETHYL ESTER	0.433
TRIFLOXYSTROBIN	0.083

Pesticide	Emission Factor (lbs. VOC per lb. active ingredient)
TRIFLOXYSULFURON-SODIUM	0.014
TRIFLUMIZOLE	0.067
TRIFLURALIN	0.737
TRINEXAPAC-ETHYL	2.386
TRITICONAZOLE	0.240
UNICONIZOLE-P	125.636
VINCLOZOLIN	0.055
ZINC CHLORIDE	0.329
ZINEB	0.082
ZIRAM	0.031

## AGRICULTURAL TILLING

### A. Source Category Description

Fugitive dust emissions from agricultural tilling include the airborne soil particulate emissions produced during the preparation of agricultural lands for planting. Fugitive dust emissions from agricultural tilling are estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Since there are no PM-CON emissions for this category, PM10-PRI emissions are equal to PM10-FIL emissions and PM25-PRI emissions are equal to PM25-FIL. The total emissions for 2014 from agricultural tilling are 3,717,211 tons for PM10-FIL, 3,717,211 tons for PM10-PRI, 743,442 tons for PM25-FIL, and 743,442 tons for PM25-PRI.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2801000003	Miscellaneous Area Sources	Agriculture Production - Crops	Agriculture - Crops	Tilling

### B. Overview of Calculations

The calculations for estimating emissions from agricultural tilling involves distributing state-level tilling data by tilling type (conservation, no-till, and conventional) to the county level and calculating a ratio of conservation, no-till, and conventional tilling for each county. That ratio is used to estimate the type of tillage for each crop type for each tilling type in each county. The type of tillage is used to develop a county-level emissions factor for each crop type and tilling type, which is used to calculate county-level PM10-FIL, PM10-PRI, PM25-FIL, and PM25-PRI emissions. Sources of data and calculations for the acres tilled by conservation type and acres of crops harvested are discussed in section C. The process of allocating tilling data by type to the county level is discussed in section D. The calculations of the emissions factors are discussed in section E. The estimation of emissions from agricultural tilling is discussed in section G.

### C. Activity Data

The basis of agricultural tilling emission estimates is the number of acres of crops tilled in each county by crop type and tillage type. These data are obtained from the *2012 Census of Agriculture* developed by the United States Department of Agriculture.<sup>1</sup> The USDA Census of Agriculture reports acres harvested for a given crop at the county level, but does not provide tilling data for each crop type at the county level.

The USDA Census of Agriculture redacts some county level data to avoid disclosing data for individual farms. Missing county-level data for acres harvested by crop type and tilling type are calculated using the difference between the state and national level reported data and the sum of the county-level data by state.

When county level tilling data are unavailable, the total state level tilling data by tilling type, conservation, no-till, and conventional are distributed to the county level for each crop. The difference between the county-level data for acres harvested by crop tilling type and the state-level data for acres harvested by crop tilling are equally distributed to the counties without data.

$$a_{m,t} = \frac{a_{s,t} - \sum a_{c,t}}{C_{m,t}} \quad (1)$$

Where:

- $a_{m,t}$  = County-level land tilled by crop tilling type,  $t$ , for counties missing tilling data,  $m$ , in acres
- $a_{s,t}$  = Land tilled by crop tilling type  $t$  in state  $s$ , in acres
- $a_{c,t}$  = Sum of county-level land tilled by crop tilling type,  $t$ , in acres
- $C_{m,t}$  = Number of counties missing county-level land tilled data by crop tilling type,  $t$

USDA provides data on the number of acres tilled by tillage type (conservation, no-till, and conventional) in each county,<sup>2</sup> but not by tillage type and crop type in each county. To estimate tillage by crop type in each county, a ratio is determined based on the number of acres in each county tilled by each tillage type to the total acres tilled by all tillage types. This calculation uses either the data directly reported by USDA or the data gap-filled by equation 1.

$$r_{c,t} = \frac{a_{c,t} \text{ (or } a_{m,t})}{\sum a_{c,t} \text{ (or } a_{m,t})} \quad (2)$$

Where:

- $r_{c,t}$  = Ratio of crop tilling type  $t$  to total all crop tilling types in county  $c$
- $a_{c,t}$  = Land tilled by crop tilling type  $t$  in county  $c$ , in acres
- $a_{m,t}$  = Land tilled by crop tilling type  $t$  for counties missing data,  $m$ , in acres

The ratio is then used to estimate the county-level acres harvested by crop type from the *2012 Census of Agriculture* to the tilling type (conservation, no-till, and conventional) at the county-level.

$$a_{t,c,x} = r_{c,t} \times a_{c,x} \quad (3)$$

Where:

- $a_{t,c,x}$  = Land tilled by crop tilling type  $t$  and crop type  $x$  in county  $c$ , in acres
- $r_{c,t}$  = Ratio of crop tilling type  $t$  to total all crop tilling types in county  $c$
- $a_{c,x}$  = Acres harvested of crop type  $x$  in county  $c$ , in acres

Tilling data for permanent pasture followed a different methodology. Conventional tilling data are available for the state of Utah.<sup>3</sup> For Utah, a ratio of the conventional tilling acres to the total acres of permanent pasture is developed (0.0023) and applied to the total acreage data for permanent pasture from the *2012 Census of Agriculture* to determine the number of conventional tilled permanent pasture acres by county in other states. It is assumed that the remainder of the permanent pasture acres is not tilled, so the remaining distribution of permanent pasture acres is then distributed to no till acres and conservation tilling acres are left as zero.

A summary of national-level acres tilled in 2012 for each tilling type are presented in Table 1.

**Table 1. Acres Tilled by Tillage Type, in 2012**

Tillage System	Actual National Number of Acres Tilled in 2012 (million acres)
No-Till	658.07
Conservation	162.19
Conventional	273.16
<b>Total</b>	<b>1,093.42</b>

Source: Reference 1

#### D. Allocation Procedure

The activity data are reported at the county level. Allocation for this source category is not needed.

#### E. Emissions Factors

The county-level emissions factors for agricultural tilling are specific to the crop and tilling type (e.g. conventional tillage corn, no-till soybean, etc.) and are calculated using the following equation.<sup>4,5</sup>

$$EF_{p,t,x,c} = c \times k \times s_c^{0.6} \times p_t \quad (4)$$

Where:

- $EF_{p,t,x,c}$  = Emissions factor for pollutant  $p$ , crop tilling type  $t$ , and crop type  $x$  in county  $c$ , in lbs./acre
- $c$  = Constant 4.8 lbs./acre-pass
- $k$  = Dimensionless particle size multiplier (PM10-FIL and PM10-PRI = 0.21; PM25-FIL and PM25-PRI = 0.042)
- $s_c$  = Percent silt content of surface soil (%) in county  $c$ , defined as the mass fraction of particles smaller than 50  $\mu\text{m}$  diameter found in surface soil
- $p_t$  = Number of passes or tillings in a year by crop tilling type,  $t$

The U.S. Department of Agriculture and the National Cooperative Soil Survey define silt content of surface soil as the percentage of particles (mass basis) of diameter smaller than 50 micrometers ( $\mu\text{m}$ ) found in the surface soil.\* The soil sample data used to estimate county-level, average silt content values are from the National Cooperative Soil Survey Microsoft Access Soil Characterization Database.<sup>6</sup> This database contains the most commonly requested data from the National Cooperative Soil Survey Laboratories including data from the Kellogg Soil Survey Laboratory and cooperating universities.

EPA applied specific selection criteria to the database to ensure that all samples are comparable and relevant to this analysis. The selection criteria included selecting only samples taken inside the United States with a preparation code of S and a horizon top of zero centimeters or a master horizon of A or O. A preparation code of S signifies that the sample is the air-dried whole soil passing through a 3 inch sieve and a horizon top of zero or master horizon of A or O ensures that the sample is taken at the surface.

In some cases, the sample metadata did not indicate a county, but included latitude and longitude coordinates. In these cases, the state and county information are determined based on the latitude and longitude coordinates and added to the sample entry in the database.

The average silt content for a county is calculated by summing the total silt content of all the samples in the county and dividing by the number of samples in the county. For counties without samples, the average silt content is calculated by summing the total silt content of soil samples in neighboring counties and dividing by the number of samples in the neighboring counties. If neighboring counties also lacked sample data, then the county is assigned the average silt value of soil samples within the state.

Table 2 shows the number of passes or tillings in a year for each crop for conservation use, no-till and conventional use.<sup>7</sup> These values are used as  $p_t$  in equation 1 to estimate the county-level emissions factors. Mulch till and ridge till tillage systems are classified as conservation use, while 0 to 15 percent residue and 15 to 30 percent residue tillage systems are classified as conventional use.

**Table 2. Number of Passes or Tillings per Year.**

Crop	Conservation Use	No-Till	Conventional Use
Barley	3	3	5
Beans	3	3	3
Canola	3	3	3
Corn	1	0	2
Cotton	5	5	8
Cover	1	1	1
Fallow	1	1	1

\* Note that this definition is different than the U.S. Environmental Protection Agency's definition that includes all particles (mass basis) of diameter smaller than 75 micrometers.

Crop	Conservation Use	No-Till	Conventional Use
Fall-seeded/Winter Wheat	3	3	5
Forage	3	3	3
Hay	3	3	3
Oats	3	3	5
Peanuts	3	3	3
Peas	3	3	3
Permanent Pasture	0	0	1
Potatoes	3	3	3
Rice	5	5	5
Rye	3	3	5
Sorghum	1	1	6
Soybeans	1	0	2
Spring Wheat	1	1	4
Sugarbeets	3	3	3
Sugarcane	3	3	3
Sunflowers	3	3	3
Tobacco	3	3	3

Source: Woodard 1996<sup>7</sup>

## F. Controls

There are no controls assumed for this category.

## G. Emissions

Particulate matter emissions from agricultural tilling are computed by multiplying crop- and county-specific emissions factors by crop- and county-specific data on tilling activity. The emissions are then summed across all tilling types and crop types.

$$E_{p,c} = \sum_{t=1}^T \sum_{x=1}^X EF_{p,t,x,c} \times a_{t,c} \times \frac{1 \text{ ton}}{2000 \text{ lb}} \quad (5)$$

Where:

- $E_{p,c}$  = Annual total agricultural tilling county level emissions of pollutant  $p$  in county  $c$  from all crop tilling types, in tons
- $EF_{p,t,x,c}$  = Emissions factor for pollutant  $p$ , crop tilling type  $t$ , and crop type  $x$  in county  $c$ , in lbs./acre
- $a_{t,x,c}$  = Land tilled by crop tilling type  $t$ , and crop type  $x$  in county  $c$ , in acres

## H. Point Source Subtraction

There are no point source-specific SCCs for agricultural tilling; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 provides a sample calculation for PM10-FIL emissions for conservation tilling from corn in Clay County, Alabama. For total PM10-FIL emissions, the calculations below would need to be repeated for all crop types for all three tilling types, and then summed in equation 5 for total emissions.

**Table 3. Sample calculations for PM10-FIL emissions from conservation tilling from corn in Clay County, AL.**

Eq. #	Equation	Values for Clay County, AL	Result
1	$a_{m,t} = \frac{a_{s,t} - \sum a_{c,t}}{C_{m,t}}$	$\frac{311,942 \text{ acres} - 298,042 \text{ acres}}{13 \text{ missing counties}}$	1,069.23 acres for conservation tilling in Clay County, AL
2	$r_{c,t} = \frac{a_{c,t} \text{ (or } a_{m,t})}{\sum a_{c,t} \text{ (or } a_{m,t})}$	$\frac{1,069.23 \text{ acres}}{1,489.23 \text{ acres}}$	0.718 ratio of conservation tilling to all tilling for Clay County, AL
3	$a_{t,c,x} = r_{c,t} \times a_{c,x}$	$0.718 \times 89 \text{ acres}$	63.9 acres corn harvested using conservation tilling in Clay County, AL
4	$EF_{p,t,x,c} = c \times k \times s_c^{0.6} \times p_t$	$4.8 \frac{\text{pounds}}{\text{acre-pass}} \times 0.21 \times 28.93^{0.6} \times 1 \text{ pass}$	7.59 pounds per acre for conservation tilling from corn in Clay County, AL
5	$E_{p,c} = \sum_{t=1}^T \sum_{x=1}^X EF_{p,t,x,c} \times a_{t,c} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	$7.59 \frac{\text{pounds}}{\text{acre}} \times 63.9 \text{ acres} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	0.24 tons PM10-FIL emissions from conservation tilling for corn in Clay County, AL*

\* Note that this calculation must be completed for all crop types and tilling types in the county to determine the total emissions for that county.

## J. Changes from 2014 Methodology

There are no significant changes for this methodology from the methodology used for the 2014 NEI.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> U.S. Department of Agriculture. *2012 Census of Agriculture*. <https://www.agcensus.usda.gov/Publications/2012/>
- <sup>2</sup> Personal communication from Christy Meyer, U.S. Department of Agriculture, National Agricultural Statistics Service to Marissa Hoer, Abt Associates, September 2015.
- <sup>3</sup> Personal communication from Greg Mortensen, Utah Department of Environmental Quality to Jonathan Dorn, Abt Associates, 2014\_UtahDeptAg\_DNR\_Tilling\_Stats.xlsx, February 2016.
- <sup>4</sup> U.S. Environmental Protection Agency. 1985. *Compilation of Air Pollutant Emission Factors*, 4th Edition, AP-42, Volume I: Stationary Point and Area Sources, page 11.2.2-1. Research Triangle Park, North Carolina.
- <sup>5</sup> Midwest Research Institute. 1981. *The Role of Agricultural Practices in Fugitive Dust Emissions*, page 117. Prepared for California Air Resources Board.
- <sup>6</sup> U.S. Department of Agriculture, National Cooperative Soil Survey, NCSS Microsoft Access Soil Characterization Database. <http://ncsslabsdatamart.sc.egov.usda.gov/>
- <sup>7</sup> Woodard, Kenneth R. 1996. *Agricultural Activities Influencing Fine Particulate Matter Emissions*, Midwest Research Institute; corn and soybean tilling passes updated based on data from Kansas and Iowa. [https://www3.epa.gov/ttn/chief/old/ap42/ch09/s01/related/rel03\\_c09s01.pdf](https://www3.epa.gov/ttn/chief/old/ap42/ch09/s01/related/rel03_c09s01.pdf)

## ASPHALT PAVING

### A. Source Category Description

Asphalt paving is the process of applying asphalt concrete to seal or repair the surface of roads, parking lots, driveways, walkways, or airport runways. Asphalt concrete is a composite material comprised of a binder and a mineral aggregate. The binder, referred to as asphalt cement, is a byproduct of petroleum refining and contains the semi-solid residual material left after the more volatile chemical fractions have been distilled off.

Asphalt cements thinned with water and an emulsifying agent are known as emulsified asphalts. Asphalt cements thinned with petroleum distillates are known as cutback asphalts; cut-back asphalt is produced by thinning the binder in diluent containing 25 to 45 percent petroleum distillates by volume prior to mixing with the aggregate. Thinning reduces the viscosity of the asphalt making it easier to work with the mixture. The primary uses of asphalt cements include tack and seal operations, priming roadbeds, and paving operations for pavements up to several inches thick.

Estimates of emissions of volatile organic compounds (VOC), and hazardous air pollutants (HAPs) from asphalt paving are based on the amount of cutback and emulsified asphalt used. In 2014, cutback asphalt use in the US, Puerto Rico, and US Virgin Islands resulted in approximately 77,609 tons of VOC and emulsified asphalt use in the US, Puerto Rico, and US Virgin Islands resulted in 134,706 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2461021000	Solvent Utilization	Misc Non-industrial: Commercial	Cutback Asphalt	Total: All Solvent Types
2461022000	Solvent Utilization	Misc Non-industrial: Commercial	Emulsified Asphalt	Total: All Solvent Types

Note that these source categories do not include emissions from the use of hot mix asphalt (HMA) or warm mix asphalt (WMA).

### B. Overview of Calculations

The calculations for estimating the emissions from asphalt use involve first estimating the amount of cutback and emulsified asphalt used in each county. The amount of state-level cutback and emulsified asphalt used in 2008 is available from an Asphalt Institute report. Asphalt use is adjusted to 2013 using a ratio of the vehicle miles traveled (VMT) in the US in 2013 to US VMT in 2008. The amount of state-level asphalt used is then distributed to the counties based on the county-level utilization of paved roads. The total amount of asphalt used is multiplied by emissions factors for VOC and HAPS to estimate emissions of these pollutants from asphalt usage. Sources of data and calculations for the amount of asphalt used are discussed in section C. The process of allocating asphalt activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from asphalt use is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of cutback and emulsified asphalt used, which is from a 2008 survey from the Asphalt Institute.<sup>1</sup> The 2008 data are used for the 2008, 2011, and 2014 NEI, as research suggests that more recent data are not readily available. The 2008 asphalt data are adjusted to account for changing use of roads, parking lots, driveways, walkways, or airport runways, using ratio of US VMT in 2013 to US VMT in 2008. State-level VMT data are obtained from the Federal Highway Administration (FHWA) report: *State-level annual vehicle miles traveled (VMT) by FHWA road class, 2013*.<sup>2</sup> (1)

$$VMTFrac = \frac{VMT_{US,y}}{VMT_{US,2008}}$$

$$AU_{s,t} = VMTFrac \times UAU_{s,t} \quad (2)$$

Where:

- $VMTFrac$  = The fraction of US VMT in 2008 to US VMT in 2013  
 $VMT_{US,2008}$  = Total VMT in the US in 2008  
 $VMT_{US,y}$  = Total VMT in the US in 2013  
 $AU_{s,t}$  = The amount of asphalt type  $t$  used in state  $s$ , in tons of asphalt per year, from equation 2  
 $UAU_{s,t}$  = The amount of unadjusted asphalt type  $t$  used in state  $s$ , in tons of asphalt per year, from Table 1

Table 1 shows the total state-level amount of cutback and emulsified asphalt used in the U.S in 2008.

The process used to distribute the state-level amount of asphalt used to the counties is discussed in section D.

**Table 1. State-level Asphalt Usage in 2008**

State	Cutback Asphalt Usage (Tons)	Emulsified Asphalt Usage (Tons)
Alabama	1,728	18,988
Alaska	0	1,108
Arizona	7,917	62,416
Arkansas	1,442	9,201
California	30,657	151,767
Colorado	331	837
Connecticut	0	0
Delaware	0	0
District of Columbia	0	150
Florida	809	19,459
Georgia	1,136	7,848
Hawaii	0	0
Idaho	2,880	41,805
Illinois	18,889	146,873
Indiana	290	17,427
Iowa	4,874	13,570
Kansas	3,641	0
Kentucky	456	16,137
Louisiana	175	6,418
Maine	0	0
Maryland	0	2,080
Massachusetts	0	805
Michigan	52	31,250
Minnesota	1,604	67,082
Mississippi	259	45,035
Missouri	7,385	36,933
Montana	1,614	17,880
Nebraska	2,997	35,376
Nevada	948	15,971
New Hampshire	0	0
New Jersey	0	0
New Mexico	320	58,048
New York	0	32,954
North Carolina	0	143
North Dakota	7,323	22,701
Ohio	3,214	22,777
Oklahoma	8,724	9,157

Oregon	865	34,918
Pennsylvania	26,844	69,671
Rhode Island	0	0
South Carolina	0	0
South Dakota	19,034	44,691
Tennessee	894	34,561
Texas	14,618	154,613
Utah	549	7,039
Vermont	0	0
Virginia	670	41,249
Washington	5,774	24,263
West Virginia	0	3,581
Wisconsin	8,188	18,925
Wyoming	227	5,292

Source: Asphalt Institute

#### D. Allocation Procedure

Asphalt usage data are not available at the county-level, therefore state –level data are allocated to the county based on road utilization numbers calculated from FHWA data.

State-level VMT data are obtained from the FHWA report: *State-level annual vehicle miles traveled (VMT) by FHWA road class, 2013*.<sup>3</sup> EPA used the state-level data and 2011 MOVES data to allocate VMT to the county-level.

$$VMT_{c,r} = MOVES_{c,r} \times \frac{VMT_{s,r}}{MOVES_{s,r}} \quad (3)$$

Where:

- $VMT_{c,r}$  = The amount of VMT on road type  $r$  in county  $c$  from EPA, in millions of miles
- $MOVES_{c,r}$  = The amount of VMT on road type  $r$  in county  $c$  from the 2011 MOVES run
- $VMT_{s,r}$  = The amount of VMT on road type  $r$  in state  $s$  from FHWA, in millions of miles
- $MOVES_{s,r}$  = The amount of VMT on road type  $r$  in state  $s$  from the 2011 MOVES run

The county-level VMT is used to calculate the fraction of VMT in each county.

$$VMTFr_{c,r} = \frac{VMT_{c,r}}{VMT_{s,r}} \quad (4)$$

Where:

- $VMTFr_{c,r}$  = The fraction of VMT on road type  $r$  in county  $c$
- $VMT_{c,r}$  = The amount of VMT on road type  $r$  in county  $c$  from EPA, in millions of miles
- $VMT_{s,r}$  = The amount of VMT on road type  $r$  in state  $s$  from FHWA, in millions of miles

State-level lane-miles<sup>4</sup> and paved road miles<sup>5</sup> from FHWA are used to calculate an estimate of state lane-miles that are paved by road type.

$$PLM_{s,r} = \frac{PM_{s,r}}{PUM_{s,r}} \times LM_{s,r} \quad (5)$$

Where:

- $PLM_{s,r}$  = The amount of paved lane-miles of road type  $r$  in state  $s$ , in miles
- $PM_{s,r}$  = The amount of paved road miles of road type  $r$  in state  $s$  from FHWA, in miles
- $PUM_{s,r}$  = The amount of paved and unpaved miles of road type  $r$  in state  $s$  from FHWA, in miles
- $LM_{s,r}$  = The amount of lanes miles of road type  $r$  in state  $s$  from FHWA, in miles

State-level VMT from FHWA and paved lane-miles (from equation 3) are used to calculate a state-level utilization measure for paved roads by road type.

$$U_{s,r} = \frac{VMT_{s,r}}{PLM_{s,r}} \quad (6)$$

Where:

$$\begin{aligned} U_{s,r} &= \text{Utilization of paved road type } r \text{ in state } s \\ VMT_{s,r} &= \text{The amount of VMT on road type } r \text{ in state } s \text{ from FHWA} \\ PLM_{s,r} &= \text{The amount of paved lane-miles of road type } r \text{ in state } s \end{aligned}$$

County-level utilization of paved roads by road type is calculated based on the fraction of county-level VMT (from equation 2).

$$U_{c,r} = VMTFr_{c,r} \times U_{s,r} \quad (7)$$

Where:

$$\begin{aligned} U_{c,r} &= \text{Utilization of paved road type } r \text{ in state } s \\ VMTFr_{c,r} &= \text{The fraction of VMT on road type } r \text{ in county } c \\ U_{s,r} &= \text{Utilization of paved road type } r \text{ in state } s \end{aligned}$$

County-level utilization values are summed across all road types and then summed to the state level.

$$U_c = \sum_r U_{c,r} \quad (8)$$

$$U_s = \sum_c U_c \quad (9)$$

Where:

$$\begin{aligned} U_s &= \text{The total utilization of paved roads in state } s \\ U_c &= \text{The total utilization of paved roads in county } c \\ U_{c,r} &= \text{Utilization of paved road type } r \text{ in state } s \end{aligned}$$

The fraction of county-level utilization is calculated based on the ratio of total utilization at the county level to state level.

$$UFr_c = \frac{U_c}{U_s} \quad (10)$$

Where:

$$\begin{aligned} UFr_c &= \text{The fraction of paved road utilization in county } c \\ U_s &= \text{The total utilization of paved roads in state } s \\ U_c &= \text{The total utilization of paved roads in county } c \end{aligned}$$

County-level asphalt usage is calculated by multiplying the fraction of county-level paved road utilization by the amount of cutback and emulsified asphalt used from Table 1.

$$AU_{c,t} = UFr_c \times AU_{s,t} \quad (11)$$

Where:

- $AU_{c,t}$  = The amount of asphalt type  $t$  used in county  $c$ , in tons of asphalt per year  
 $UFR_c$  = The fraction of paved road utilization in county  $c$   
 $AU_{s,t}$  = The amount of asphalt type  $t$  used in state  $s$ , in tons of asphalt per year, from Table 1

## E. Emissions Factors

Emissions factors for asphalt paving are reported in Table 4 and Table 5. The emissions factors for VOC and HAPs are developed based on information from material safety and data sheets (MSDS) for cutback<sup>6</sup> and emulsified<sup>7</sup> asphalt.

**Table 2. Chemical Composition Assumptions for Cutback Asphalt**

Pollutant	Average % by Weight	% Weight Volatilized
Naphtha	40	95
Naphthalene & PAH	0.58	95
Toluene	0.59	95
Xylene	0.99	95
Benzene	0.19	95
Ethylbenzene	0.49	95
Hydrogen Sulfide	0.09	95

Source: Average of MSDS values, reference 6

**Table 3. Chemical Composition Assumptions for Emulsified Asphalt**

Pollutant	Average % by Weight	% Weight Volatilized
Naphtha	10	95
Naphthalene & PAH	0.29	95
Hydrogen Sulfide	0.09	95

Source: Average of MSDS values, reference 7

Emissions factors for HAPs are calculated using the assumptions found in Table 2 and Table 3. The total amount of cutback asphalt used nationally is 190,613 tons and the amount of emulsified asphalt used is 1,374,693 tons.

$$Z_{US,p,t} = AU_{US,t} \times 2000 \frac{lbs.}{ton} \times \%W_{p,t} \times \%V_p \quad (12)$$

$$EF_{p,t} = \frac{Z_{US,p,t}}{AU_{US,t}} \quad (13)$$

Where:

- $Z_{US,p,t}$  = The amount of pollutant  $p$  emitted from use of asphalt type  $t$  in the United States, in lbs. of pollutant per year  
 $EF_{p,t}$  = Emissions factor for pollutant  $p$  from asphalt type  $t$ , in lbs. of pollutant per ton of asphalt  
 $AU_{US,t}$  = Total usage of asphalt type  $t$ , in tons of asphalt per year  
 $\%W_{p,t}$  = Average percent by weight of pollutant  $p$  from asphalt type  $t$   
 $\%V_p$  = Average percent weight of pollutant  $p$  volatilized

Emissions factors for VOC are calculated by summing the amount of pollutant emitted each year for all HAPs,

except hydrogen sulfide.

$$EF_{voc,t} = \frac{\sum_p Z_t}{AU_{US,t}} \quad (14)$$

Where:

- $EF_{voc,t}$  = VOC emissions factor for asphalt type  $t$ , in lbs. of VOC per ton of asphalt
- $Z_{p,t}$  = The amount of pollutant emitted from use of asphalt type  $t$ , where  $p$  is equal to all pollutants except hydrogen sulfide, in lbs. of pollutant per year
- $AU_{US,t}$  = Total usage of asphalt type  $t$ , in tons of asphalt per year

**Table 4. Emissions Factors for Cutback Asphalt Usage**

Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units
Volatile Organic Compounds	VOC	813.96	lbs./ton asphalt
Benzene	71432	3.6	lbs./ton asphalt
Ethylbenzene	100414	9.3	lbs./ton asphalt
Naphthalene	91203	11.0	lbs./ton asphalt
Toluene	108883	11.2	lbs./ton asphalt
Xylenes (mixed isomers)	1330207	18.8	lbs./ton asphalt
Hydrogen Sulfide	7783064	1.7	lbs./ton asphalt

Source: Based on MSDS values from Table 2

**Table 5. Emissions Factors for Emulsified Asphalt Usage**

Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units
Volatile Organic Compounds	VOC	195.5	lbs./ton asphalt
Naphthalene	91203	5.5	lbs./ton asphalt
Hydrogen Sulfide	7783064	1.7	lbs./ton asphalt

Source: Based on MSDS values from Table 3

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The total asphalt usage in each county is multiplied by the emissions factors in Table 4 and Table 5 to estimate emissions.

$$E_{p,c,t} = EF_{p,t} \times AU_{c,t} \quad (15)$$

Where:

- $E_{p,c,t}$  = Annual emissions of pollutant  $p$  in county  $c$  from use of asphalt type  $t$ , in lbs. of pollutant
- $EF_{p,t}$  = Emissions factor for pollutant  $p$  from asphalt type  $t$ , in lbs. of pollutant per ton of asphalt
- $AU_{c,t}$  = The amount of asphalt type  $t$  used in county  $c$ , in tons of asphalt per year

## H. Point Source Subtraction

There are no point source-specific SCCs for asphalt paving; therefore point source subtraction is not performed for this category. There are point source SCCs for asphalt manufacturing, but these do not apply to asphalt paving.

## I. Sample Calculations

Table 6 lists sample calculations to determine the VOC emissions from emulsified asphalt used in Barnstable County, Massachusetts. The equations 2 through 7 use asphalt use on rural interstates as an example; however, these calculations would need to be repeated for all 14 FHWA road types.

**Table 6. Sample calculations for VOC emissions from emulsified asphalt use in Barnstable County, Massachusetts.**

Eq. #	Equation	Values for Barnstable County, MA	Result
1	$\frac{VMTFr}{VMT_{US,y}} = \frac{VMT_{US,2008}}{VMT_{US,2008}}$	$\frac{3,025,659 \text{ Million Miles}}{2,973,509 \text{ Million Miles}}$	1.02 VMT fraction between 2008 and 2013
2	$AU_{s,t} = VMTFrac \times UAU_{s,t}$	$1.02 \times 805 \text{ tons of emulsified asphalt in MA}$	819 tons of adjusted emulsified asphalt used in MA
3	$\frac{VMT_{c,r}}{MOVES_{c,r}} \times \frac{MOVES_{s,r}}{MOVES_{s,r}}$	Barnstable County VMT on rural interstates from EPA	153,721,475.26 vehicle miles traveled on rural interstates in Barnstable County, MA
4	$\frac{VMTFr_{c,r}}{\frac{VMT_{c,r}}{VMT_{s,r}}}$	$\frac{153.72 \text{ million vehicle mi. in Barnstable County}}{778.15 \text{ million vehicle mi. in MA}}$	0.198 fraction of rural interstate VMT in Barnstable County, MA
5	$\frac{PLM_{s,r}}{\frac{PM_{s,r}}{PUM_{s,r}}} \times LM_{s,r}$	$\frac{63.65 \text{ paved mi.}}{63.65 \text{ total mi.}} \times 275.25 \text{ lane mi.}$	275.25 rural interstate paved lane miles in MA
6	$U_{s,r} = \frac{VMT_{s,r}}{PLM_{s,r}}$	$\frac{778.15 \text{ million vehicle mi. in MA}}{275.25 \text{ paved lane mi. in MA}}$	2.83 utilization factor of paved rural interstates in MA
7	$U_{c,r} = VMTFr_{c,r} \times U_{s,r}$	$0.198 \text{ VMT fraction} \times 2.83 \text{ utilization factor}$	0.558 utilization factor of paved rural interstates in Barnstable County, MA
8	$U_c = \sum_r U_{c,r}$	$\sum \text{Utilization of all paved roads in Barnstable}$ (This is based on repeating calculations for equations 1-5 for all 14 FHWA road types.)	2.18 Barnstable County utilization of paved roads in MA
9	$U_s = \sum_c U_c$	$\sum \text{Utilization of paved roads in all counties in MA}$	46.20 utilization of paved roads in MA
10	$UFR_c = \frac{U_c}{U_s}$	$\frac{2.18 \text{ utilization in Barnstable County}}{46.20 \text{ utilization in MA}}$	0.05 fraction of utilization of paved roads in Barnstable County, MA
11	$AU_{c,t} = UFR_c \times AU_{s,t}$	$0.05 \text{ fraction utilized in Barnstable County} \times 819 \text{ tons emulsified asphalt in MA}$	37.91 tons of emulsified asphalt used in Barnstable County, MA
12	$P_{p,t} = AU_{US,t} \times \frac{2000 \frac{\text{lbs.}}{\text{ton}}}{\%W_{p,t} \times \%W_p}$	$1,350,999 \text{ tons emulsified asphalt per year} \times \frac{2000 \frac{\text{lbs.}}{\text{ton}}}{\%W_{p,t} \times \%W_p} \times 0.10 \times 0.95$	256,689,810 lbs. naphtha emitted per year from emulsified asphalt

Eq. #	Equation	Values for Barnstable County, MA	Result
		$1,350,999 \text{ tons emulsified asphalt per year} \times 2000 \frac{\text{lbs.}}{\text{ton}} \times 0.0029 \times 0.95$	7,444,004 lbs. naphthalene emitted per year from emulsified asphalt
13	$EF_p = \frac{P_p}{AU_{US,t}}$	N/A	Emissions factors for HAPs are not used to calculate the emissions factor for VOC
14	$EF_{voc,t} = \frac{\sum_p Z_t}{AU_{US,t}}$	$\frac{256,689,810 \text{ lbs. naptha} + 7,444,004 \text{ lbs. naphthalene}}{1,350,999 \text{ tons of emulsified asphalt}}$	195.51 lbs. VOC emitted per ton of emulsified asphalt used
15	$E_{p,c,t} = EF_{p,t} \times AU_{c,t}$	$195.51 \text{ lbs. VOC per ton emulsified asphalt} \times 37.91 \text{ tons emulsified asphalt}$	7,411.78 tons VOC emitted from emulsified asphalt use in Barnstable County, MA

## J. Changes from 2014 Methodology

State-level asphalt use is adjusted in the 2017 methodology using a ratio of VMT in the inventory year to VMT in 2008, the year of the original asphalt data..

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, so emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island County, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> Asphalt Institute, 2008. *2008 Asphalt Usage Survey for the United States and Canada*.  
<http://www.asphaltinstitute.org/>
- <sup>2</sup> FHWA, 2013. *Functional System Travel-2013, Annual Vehicle Miles (Table VM-2)*.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2013/vm2.cfm>
- <sup>3</sup> FHWA, 2013. *Functional System Travel-2013, Annual Vehicle Miles (Table VM-2)*.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2013/vm2.cfm>
- <sup>4</sup> FHWA, 2013. *Functional System Lane-Length-2013, Lane-Miles (Table HM-60)*.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2013/hm60.cfm#foot1>
- <sup>5</sup> FHWA, 2013. *Functional System Length-2013, Miles by Type of Surface (Table HM-51)*.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2013/hm51.cfm>
- <sup>6</sup> Cutback Asphalt MSDS

<i>Product Supplier</i>	<i>MSDS/SDS ID</i>
Valero	2013V04
Asphalt Emulsion Industries	CUT-SDS-1
Martin Asphalt Company	Jan 2007
Mohawk Asphalt Emulsions	UN1999
Asphalt & Fuel Supply	211
Valero	211
Valero	210

- <sup>7</sup> Emulsified Asphalt MSDS

<i>Product Supplier</i>	<i>MSDS/SDS ID</i>
Marathon	0137MAR019
Marathon	0138MAR019
Asphalt Emulsion Industries	EMU-SDS-1
U.S. Oil & Refining Co.	951

## AVIATION GASOLINE DISTRIBUTION-STAGE 1

### A. Source Category Description

Aviation gasoline (also called “AvGas”) is the only aviation fuel that contains lead as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.<sup>1</sup> Commercial and military aviation rarely use this fuel. AvGas is shipped to airports and is filled into bulk terminals, and then into tanker trucks. These processes fall under the definition of stage 1, displacement vapors during the transfer of gasoline from tank trucks to storage tanks, and vice versa. In 2014, aviation gasoline distribution-stage 1 in the US, Puerto Rico, and US Virgin Islands resulted in approximately 30,585 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080050	Storage and Transport	Petroleum and Petroleum Product Storage	Airports : Aviation Gasoline	Stage 1: Total

### B. Overview of Calculations

The calculations for estimating emissions from stage 1 aviation gasoline distribution involve first estimating the amount of aviation gasoline consumed in each county, based on state-level aviation gasoline consumption data from the Energy Information Administration (EIA). State-level aviation gasoline consumption is distributed to the counties based on the proportion of Landing-Take Offs (LTOs). The total amount of gasoline consumed is used to estimate non-fugitive and fugitive VOC emissions, as well as hazardous air pollutant (HAP) emissions. Sources of data and calculations for the amount of aviation gasoline consumed are discussed in section C. The process of allocating aviation gasoline activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from stage 1 of aviation gasoline distribution is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of aviation gasoline consumed, which is estimated using data from the EIA’s State Energy Data System (SEDS).<sup>2</sup> The SEDS MSN Code AVTCP is used to identify the total consumption of aviation gasoline in units of thousand barrels. Data are then converted to units of gallons.

$$AG_s = AGB_s \times 42 \frac{\text{gallons}}{\text{barrel}} \quad (1)$$

Where:

$AG_s$  = Annual consumption of AvGas for state  $s$ , in gallons  
 $AGB_s$  = Annual consumption of AvGas for state  $s$ , in barrels

The process used to distribute the state-level amount of aviation gasoline consumed to the counties is discussed in section D.

### D. Allocation Procedure

State-level gasoline consumption (from equation 1) is allocated to the county-level using the ratio of county-to-state-level LTOs. State and county LTO data for 2012 were compiled by the U.S. EPA’s Office of Air Quality, Planning and Standards (OAQPS).<sup>3</sup>

$$RLTO_c = \frac{LTO_c}{LTO_s} \quad (2)$$

Where:

- $RLTO_c$  = The ratio of landing-take offs (LTOs) in county  $c$
- $LTO_c$  = The number of LTOs in county  $c$
- $LTO_s$  = The number of LTOs in state  $s$

LTO data for turbine-powered airplanes were excluded because turbine-powered planes do not use aviation gasoline. Additionally, LTOs at airports that do not have aviation gasoline refueling, according to data from FAA Form 5010, were also excluded.<sup>4</sup>

The state-level gasoline consumption values from equation 1 are multiplied by the proportion of LTOs in each county to estimate the county-level amount of aviation gasoline consumed.

$$AG_c = AG_s \times RLTO_c \quad (3)$$

Where:

- $AG_c$  = Annual consumption of AvGas in county  $c$ , in gallons
- $AG_s$  = Annual consumption of AvGas for state  $s$ , in gallons
- $RLTO_c$  = The ratio of landing-take offs (LTOs) in county  $c$

## E. Emissions Factors

Emission factors for stage 1 aviation gasoline distribution are reported in Tables 1 and 2. The emissions factors for fugitive and non-fugitive VOC are taken from the TRC report *Estimation of Alkylated Lead Emissions, Final Report*.<sup>1</sup> The emissions factors for the HAPs are taken from multiple sources: the TRC report; the EPA report *Locating and Estimating Air Emissions from Source of Ethylene Dichloride*;<sup>5</sup> a memorandum to EPA/OAQPS,<sup>6</sup> and a personal email between EPA/OAQPS employees.<sup>7</sup> The tables list the emission factors as reported in the original references, and the emission factors that have been converted (if necessary) for use in the NEI emissions calculations.

**Table 1. VOC Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080050)**

Pollutant	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
VOC	Aviation Gas Unloading/ Tank Filling - tank fill	1,081	mg/l gasoline*	9.02E-3	LB/GAL AvGas	1; Table 2-7
	Aviation Gas Unloading/ Tank Filling - Storage tank working	432		3.61E-3		
	Aviation Gas Tank Truck Filling - Composite	1,235		1.03E-2		
	Aviation Gas Storage Tank - Breathing losses	203		1.69E-3		
	Aviation Gas - Fugitive from valves	0.26	kg/valve/day	5.73E-1	LB/valve/day	
	Aviation Gas - Fugitive from pumps	2.7	kg/seal/day	5.95E0	LB/seal/day	

\* Converted from mg/l to LB/GAL using conversion factors of 3.785 liters per gallon and 453,592 mg per pound.

**Table 2. HAP Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080050)**

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
Ethylene Dichloride	107062	0.26	mg/l gasoline*	2.17E-6	LB/GAL AvGas	5
Lead**	7439921			6.27E-6	LB/ LB VOC	1
2,2,4-Trimethylpentane	540841			8.00E-3		6
Benzene	71432			9.00E-3		7
Cumene	98828			1.00E-4		6
Ethylbenzene	100414			1.00E-3		
Hexane	110543			1.60E-2		
Naphthalene	91203			5.00E-4		
Toluene	108883			1.30E-2		
Xylene	1330207			5.00E-3		

\* Converted from mg/l to LB/GAL using conversion factors of 3.785 liters per gallon and 453,592 mg per pound.

\*\* The 2011 NEI included tetraethyl lead (TEL) with an emission factor of 9.78E-6 lbs./lb. VOC. In 2017, EPA only accounts for the emissions of elemental lead. The TEL emission factor was modified by multiplying by the ratio of the atomic mass of lead to the atomic mass of TEL, or 64.06%.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The annual aviation gasoline consumed in each county is used with the emissions factors in Tables 1 and 2 to estimate emissions. Emissions of non-fugitive VOC from multiple sources, including tank truck filling and storage tank breathing, are estimated by multiplying gasoline consumed by the emissions factor in Table 1. For VOC, emissions are multiplied by a conversion factor to convert from tons to pounds.

$$NFE_{r,c} = AG_c \times EF_{VOC,r} \div 2000 \text{ lbs/ton} \quad (4)$$

Where:

$NFE_{r,c}$  = Annual non-fugitive VOC emissions for source  $r$  in county  $c$ , in tons per year

$EF_{VOC,r}$  = VOC emission factor for source  $r$ , units vary based on pollutant.

Fugitive VOC emissions from valves and pumps are estimated by multiplying gasoline consumed by the emissions factor in Table 1. Assumptions concerning bulk terminals used in these calculations can be found in Table 3.

**Table 3. Assumptions for Bulk Terminals Using Aviation Gasoline**

Parameter	Data	Reference
Number of Bulk Plant Equivalents (U.S.)	2,442 plants	1, Table 2-8
Number of valves per bulk plant	50 valves/plant	
Number of pumps per bulk plant	2 pumps/plant	
Number of seals per bulk plant	4 seals/pump	
Number of days per year used	300 days	

$$VFE_c = BPE \times V \times EF_{VOC,r} \times D \times \frac{LTO_c}{LTO_{US}} \div 2000 \text{ lbs/ton} \quad (5)$$

$$PFE_c = BPE \times P \times S \times EF_{VOC,r} \times D \times \frac{LTO_c}{LTO_{US}} \div 2000 \text{ lbs/ton} \quad (6)$$

Where:

- $PFE_c$  = Annual fugitive VOC emissions from valves in county  $c$ , in tons
- $VFE_c$  = Annual fugitive VOC emissions from pumps in county  $c$ , in tons
- $BPE$  = Number of bulk plant equivalents in the U.S.
- $V$  = Number of valves per plant in the U.S.
- $P$  = Number of pumps per plant in the U.S.
- $S$  = Number of seals per plant in the U.S.
- $D$  = Number of days used per year
- $LTO_c$  = The number of LTOs in county  $c$
- $LTO_{US}$  = The number of LTOs in the United States

Total Annual VOC emissions in each county are estimated by summing the fugitive emissions (from equations 5 and 6) and all sources of non-fugitive emissions (from equation 4).

$$E_{VOC,c} = \sum_r NFE_c + PFE_c + VFE_c \quad (7)$$

Where:

- $E_{VOC,c}$  = Annual VOC emissions in county  $c$ , in tons

Emissions of all HAPs, except ethylene dichloride, are estimated by applying speciation factors found in Table 2 to the annual VOC emissions. For HAPs, no conversion factor is needed and the emissions are reported in tons.

$$E_{h,c} = E_{VOC,c} \times SF_h \quad (8)$$

Where:

- $E_{h,c}$  = Annual emissions of HAP  $h$  in county  $c$ , in tons per year
- $SF_h$  = Speciation factor for HAP  $h$ , in tons of HAP emissions per ton of VOC emissions

Ethylene dichloride emissions are calculated by multiplying the gasoline consumed in each county (from equation 3) by the emission factor from Table 2. For ethylene dichloride, emissions are multiplied by a conversion factor to convert from to pounds tons.

$$E_{e,c} = AG_c \times EF_e \times 0.0005 \text{ tons/lb} \quad (9)$$

Where:

- $E_{e,c}$  = Annual emissions of ethylene dichloride in county  $c$ , in tons
- $EF_e$  = Emission factor for ethylene dichloride, in lbs. of ethylene dichloride per gallon of AvGas

## H. Point Source Subtraction

There are no point source-specific SCCs for stage 1 of aviation gasoline distribution; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 4 lists sample calculations to determine the VOC emissions from stage 1 aviation gasoline distribution in Autauga County, Alabama.

**Table 4. Sample Calculations for Emissions from Aviation Gasoline-Stage 1 in Autauga County, AL.**

Eq. #	Equation	Values for Autauga, AL	Result
1	$AG_s = AGB_s \times 42 \text{ gallons}/\text{barrel}$	$57,000 \text{ barrels} \times 42 \text{ gallons}/\text{barrel}$	2,394,000 gallons of AvGas consumed in AL
2	$RLTO_c = \frac{LTO_c}{LTO_s}$	$\frac{3,064 \text{ LTOs in Autauga}}{689,947 \text{ LTOs in AL}}$	0.00444 fraction of LTOs in Autauga County, AL
3	$AG_c = AG_s \times RLTO_c$	$2,394,000 \text{ gal AvGas in AL} \times 4.44 \times 10^{-3} \text{ fraction}$	10,633 gallons of AvGas consumed in Autauga County, AL
4	$NFE_{r,c} = \frac{AG_c \times EF_{VOC,r}}{2000 \text{ lbs}/\text{ton}}$	$10,633 \text{ gal AvGas in Autauga} \times 9.02 \times 10^{-3} \text{ lbs.VOC per gal AvGas} \div 2000 \text{ lbs}/\text{ton}$	0.048 tons VOC emissions from tank filling in Autauga County, AL
		$10,633 \text{ gal AvGas in Autauga} \times 3.61 \times 10^{-3} \text{ lbs.VOC per gal AvGas} \div 2000 \text{ lbs}/\text{ton}$	0.0192 tons VOC emissions from storage tank working in Autauga County, AL
		$10,633 \text{ gal AvGas in Autauga} \times 1.03 \times 10^{-2} \text{ lbs.VOC per gal AvGas} \div 2000 \text{ lbs}/\text{ton}$	0.0548 tons VOC emissions from composite in Autauga County, AL
		$10,633 \text{ gal AvGas in Autauga} \times 1.69 \times 10^{-3} \text{ lbs.VOC per gal AvGas} \div 2000 \text{ lbs}/\text{ton}$	0.00901 tons VOC emissions from breathing losses in Autauga County, AL
5	$VFE_c = \frac{BPE \times V \times EF_{VOC,r} \times D \times LTO_c}{LTO_{US} \div 2000 \text{ lbs}/\text{ton}}$	$\frac{2,442 \text{ plants in US} \times 50 \text{ valves}/\text{plant} \times 0.573 \text{ lbs.per valve per day} \times 300 \text{ days} \times 3,064}{28,353,661 \div 2000 \text{ lbs}/\text{ton}}$	1.13 tons fugitive VOC emissions from valves in Autauga County, AL
6	$PFE_c = \frac{BPE \times P \times S \times EF_{VOC,r} \times D \times LTO_c}{LTO_{US} \div 2000 \text{ lbs}/\text{ton}}$	$\frac{2,442 \text{ plants in US} \times 2 \text{ pumps}/\text{plant} \times 4 \text{ seals}/\text{pump} \times 5.95 \text{ lbs.per seal per day} \times 300 \text{ days} \times 3,064}{28,353,661 \div 2000 \text{ lbs}/\text{ton}}$	1.89 tons fugitive VOC emissions from pumps in Autauga County, AL
7	$E_{VOC,c} = \sum_r NFE_c + PFE_c + VFE_c$	$0.131 \text{ tons} + 1.13 \text{ tons} + 1.89 \text{ tons}$	3.15 total annual tons VOC emissions from AvGas distribution in Autauga County, AL

## J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, so emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island County, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity

data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are “EACH”.

## L. References

- <sup>1</sup> TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report*. Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.
- <sup>2</sup> Energy Information Administration. 2016. *State Energy Data System (SEDS): 1960-2014 (Complete)*. Consumption in Physical Units. U.S. Department of Energy. Washington, D.C.  
<http://www.eia.gov/state/seds/seds-data-complete.cfm?sid=US>
- <sup>3</sup> [LTObCyandSCC.mdb], electronic file from Laurel Driver, U.S. Environmental Protection Agency, OAQPS, to U.S. Environmental Protection Agency, OZQPS, April 4, 2013. Aircraft operations data compiled from FAA’s Terminal Area Forecasts (TAF) and 5010 Forms.
- <sup>4</sup> Federal Aviation Administration (FAA). 2017. Form 5010. Airport Data and Contact Information.  
[https://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](https://www.faa.gov/airports/airport_safety/airportdata_5010/)
- <sup>5</sup> U.S. Environmental Protection Agency. 1984. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride*. Table 16, EPA-450/4-84-007d. RTP, NC. <https://www3.epa.gov/ttn/chiefl/le/ethyldi.pdf>
- <sup>6</sup> Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP*. August 9, 1996.
- <sup>7</sup> Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

## AVIATION GASOLINE DISTRIBUTION-STAGE 2

### A. Source Category Description

Aviation gasoline (also called “AvGas”) is the only aviation fuel that contains lead as a knock-out component for small reciprocating, piston-engine crafts in civil aviation.<sup>1</sup> Commercial and military aviation rarely use this fuel. AvGas is shipped to airports and is filled into bulk terminals, and then into tanker trucks. These processes fall under the definition of stage 1, displacement vapors during the transfer of gasoline from tank trucks to storage tanks, and vice versa. Stage 2, discussed here, involves the transfer of fuel from the tanker trucks into general aviation aircraft. In 2014, aviation gasoline distribution stage 2 in the US, Puerto Rico, and US Virgin Islands resulted in approximately 1,248 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501080100	Storage and Transport	Petroleum and Petroleum Product Storage	Airports: Aviation Gasoline	Stage 2: Total

### B. Overview of Calculations

The calculations for estimating emissions from stage 2 aviation gasoline distribution involve first estimating the amount of aviation gasoline consumed in each county based on state-level aviation gasoline consumption data from the Energy Information Administration (EIA). State-level aviation gasoline consumption is distributed to the counties based on the proportion of Landing-Take Offs (LTOs). The total amount of gasoline consumed is used to estimate VOC and hazardous air pollutant (HAP) emissions. Sources of data and calculations for the amount of aviation gasoline consumed are discussed in section C. The process of allocating aviation gasoline activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from stage 1 of aviation gasoline distribution is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of aviation gasoline consumed, which is estimated using data from the EIA’s State Energy Data System (SEDS).<sup>2</sup> The SEDS MSN Code AVTCP was used to identify the total consumption of aviation gasoline in units of thousand barrels. This data were then converted to units of gallons.

$$AG_s = AGB_s \times 42 \frac{\text{gallons}}{\text{barrel}} \quad (1)$$

Where:

$$\begin{aligned} AG_s &= \text{Annual consumption of AvGas for state } s, \text{ in gallons} \\ AGB_s &= \text{Annual consumption of AvGas for state } s, \text{ in barrels} \end{aligned}$$

The process used to distribute the state-level amount of aviation gasoline consumed to the counties is discussed in section D.

### D. Allocation Procedure

State-level gasoline consumption (from equation 1) is allocated to the county-level using the ratio of county-to-state-level LTOs. State and county LTO data for 2012 were compiled by the U.S. EPA’s Office of Air Quality, Planning and Standards (OAQPS).<sup>3</sup>

$$RLTO_c = \frac{LTO_c}{LTO_s} \quad (2)$$

Where:

$RLTO_c$  = The ratio of landing-take offs (LTOs) in county  $c$   
 $LTO_c$  = The number of LTOs in county  $c$   
 $LTO_s$  = The number of LTOs in state  $s$

LTO data for turbine-powered airplanes were excluded because turbine-powered planes do not use aviation gasoline. Additionally, LTOs at airports that do not have aviation gasoline refueling, according to data from FAA Form 5010, were also excluded.<sup>4</sup>

The state-level gasoline consumption values from equation 1 are multiplied by the proportion of LTOs in each county to estimate the county-level amount of aviation gasoline consumed.

$$AG_c = AG_s \times RLTO_c \quad (3)$$

Where:

$AG_c$  = Annual consumption of AvGas in county  $c$ , in gallons  
 $RLTO_c$  = The ratio of landing-take offs (LTOs) in county  $c$

## E. Emissions Factors

Emission factors for stage 2 of aviation gasoline distribution are reported in Tables 1 and 2. The emissions factors for VOC are taken from the TRC report *Estimation of Alkylated Lead Emissions, Final Report*.<sup>1</sup> The emissions factors for the HAPs are taken from multiple sources: the TRC report; the EPA report *Locating and Estimating Air Emissions from Source of Ethylene Dichloride*;<sup>5</sup> a memorandum to EPA/OAQPS;<sup>6</sup> and a personal email between OAQPS employees.<sup>7</sup> The tables list the emission factors as reported in the original references, and the emission factors that have been converted (if necessary) for use in the NEI emissions calculations.

**Table 1. VOC Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080100)**

Pollutant	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor	Emission Factor Units	Factor Reference
VOC	Fuel Transfer from Tanker Trucks to General Aviation Aircraft	1,420*	mg/l gasoline**	8.27E-4	LB/GAL AvGas	Error! Bookmark not defined.

\* This emission factor represents the sum of the emission factor for uncontrolled displacement losses (1,340 mg/l) and spillage (80 mg/l).

\*\* Converted from mg/l to LB/GAL using conversion factors of 3.785 liters per gallon and 453,592 mg per pound.

**Table 2. HAP Emissions Factors for Aviation Gasoline Distribution-Stage 1 (2501080100)**

Pollutant	Pollutant Code	Emission Source	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Factor Reference
Ethylene Dichloride	107062	All processes	0.226*	mg/l gasoline**	1.88 E-6	LB/GAL AvGas	5
Lead***	7439921	All processes			8.50 E-8		1
2,2,4-Trimethylpentane	540841	All processes			8.00E-3	LB/ LB VOC	6
Benzene	71432	All processes			9.00E-3		7
Cumene	98828	All processes			1.00E-4		
Ethylbenzene	100414	All processes			1.00E-3		6
Hexane	110543	All processes			1.60E-2		
Naphthalene	91203	All processes			5.00E-4		
Toluene	108883	All processes			1.30E-2		
Xylene	1330207	All processes			5.00E-3		

\* This emission factor represents the sum of the emission factor for uncontrolled displacement losses (0.21 mg/l) and spillage (0.016 mg/l).

\*\* Converted from mg/l to LB/GAL using conversion factors of 3.785 liters per gallon and 453,592 mg per pound.

\*\*\* The 2011 NEI included tetraethyl lead (TEL) with an emission factor of 9.78E-6 LB/GAL AvGas. In 2014, EPA only accounts for the emissions of elemental lead. The TEL emission factor was modified by multiplying by the ratio of the atomic mass of lead to the atomic mass of TEL, or 64.06%.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The annual aviation gasoline consumed in each county is used with the emissions factors in Tables 1 and 2 to estimate emissions. Emissions of VOC are estimated by multiplying gasoline consumed by the emissions factor in Table 1. For VOC, emissions are multiplied by a conversion factor to convert from tons to pounds.

$$E_{VOC,c} = AG_c \times EF_{VOC} \times 0.0005 \text{ tons/lb} \quad (4)$$

Where:

$$\begin{aligned} E_{VOC,c} &= \text{Annual VOC emissions in county } c, \text{ in tons} \\ AG_c &= \text{Annual consumption of AvGas in county } c, \text{ in gallons} \\ EF_{VOC} &= \text{VOC emission factor, in tons of VOC per gallon of AvGas} \end{aligned}$$

Emissions of all HAPs, except ethylene dichloride and lead, are estimated by applying speciation factors found in Table 2 to the annual VOC emissions. For HAPs, no conversion factor is needed and the emissions are reported in tons.

$$E_{h,c} = E_{VOC,c} \times SF_h \quad (5)$$

Where:

$$\begin{aligned} E_{h,c} &= \text{Annual emissions of HAP } h \text{ in county } c, \text{ in tons per year} \\ E_{VOC,c} &= \text{Annual VOC emissions in county } c, \text{ in tons} \\ SF_h &= \text{Speciation factor for HAP } h, \text{ in tons of HAP emissions per ton of VOC emissions} \end{aligned}$$

Ethylene dichloride and lead emissions are calculated by multiplying the gasoline consumed consumed (from equation 3) by the emission factor from Table 2. For lead and ethylene dichloride, emissions are multiplied by a conversion factor to convert from pounds to tons.

$$E_{p,c} = AG_c \times EF_p \times 0.0005 \text{ tons/lb} \quad (6)$$

Where:

$E_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$ , in tons  
 $EF_p$  = Emission factor for pollutant  $p$ , in lbs. of pollutant per gallon of AvGas

## H. Point Source Subtraction

There are no point source-specific SCCs for stage 2 of aviation gasoline distribution; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 4 lists sample calculations to determine the VOC, lead, and ethylene dichloride emissions from stage 2 aviation gasoline distribution in Autauga County, Alabama.

**Table 3. Sample Calculations for Emissions From Aviation Gasoline-Stage 1 in Autauga County, AL.**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$AG_s = AGB_s \times 42 \text{ gallons/barrel}$	$57,000 \text{ barrels} \times 42 \text{ gallons/barrel}$	2,394,000 gallons of AvGas consumed in AL
2	$RLTO_c = \frac{LTO_c}{LTO_s}$	$\frac{3,064 \text{ LTOs in Autauga}}{689,947 \text{ LTOs in AL}}$	0.00444 fraction of LTOs in Autauga County, AL
3	$AG_c = AG_s \times RLTO_c$	$2,394,000 \text{ gal AvGas in AL} \times 4.44 \times 10^{-3} \text{ fraction}$	10,633 gallons of AvGas consumed in Autauga County, AL
4	$E_{VOC,c} = AG_c \times EF_{VOC} \times 0.0005 \text{ tons/lb}$	$10,633 \text{ gal of AvGas in Autauga} \times 0.0136 \text{ lbs. VOC per gal} \times 0.0005 \text{ tons/lb}$	0.0723 tons VOC emissions from AvGas distribution in Autauga County, AL
6	$E_{p,c} = AG_c \times EF_p \times 0.0005 \text{ tons/lb}$	$10,633 \text{ gal of AvGas in Autauga} \times 1.88 \times 10^{-6} \text{ lbs. of ethylene dichloride per gal} \times 0.0005 \text{ tons/lb}$	1.0E-5 tons ethylene dichloride emissions from AvGas distribution in Autauga County, AL
	$E_{p,c} = AG_c \times EF_p \times 0.0005 \text{ tons/lb}$	$10,633 \text{ gal of AvGas in Autauga} \times 8.50 \times 10^{-8} \text{ lbs. of lead per gal} \times 0.0005 \text{ tons/lb}$	4.52E-7 tons of lead emissions from AvGas distribution in Autauga County, AL

## J. Changes from 2014 Methodology

The only change to the methodology used to estimate the 2014 v2 NEI emissions is that the VOC emission factor for fuel transfer from tanker trucks to aircraft was decreased from 1.36E-2 lbs. VOC/gallon AvGas to 8.27E-4 lbs. VOC/gallon AvGas after reviewing the emission factor reference more carefully.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, so emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island County, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> TRC Environmental Corporation. 1993. *Estimation of Alkylated Lead Emissions, Final Report*. Prepared for the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. RTP, NC.
- <sup>2</sup> Energy Information Administration. 2016. *State Energy Data System (SEDS): 1960-2014 (Complete)*. Consumption in Physical Units. U.S. Department of Energy. Washington, D.C.  
<http://www.eia.gov/state/seds/seds-data-complete.cfm?sid=US>
- <sup>3</sup> [LTObYcTyandSCC.mdb], electronic file from Laurel Driver, U.S. Environmental Protection Agency, OAQPS, to U.S. Environmental Protection Agency, OZQPS, April 4, 2013. Aircraft operations data compiled from FAA's Terminal Area Forecasts (TAF) and 5010 Forms.
- <sup>4</sup> Federal Aviation Administration (FAA). 2017. Form 5010. Airport Data and Contact Information.  
[https://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](https://www.faa.gov/airports/airport_safety/airportdata_5010/)
- <sup>5</sup> U.S. Environmental Protection Agency. 1984. *Locating and Estimating Air Emissions from Sources of Ethylene Dichloride*. Table 16, EPA-450/4-84-007d. RTP, NC. <https://www3.epa.gov/ttn/chiefl/le/ethyldi.pdf>
- <sup>6</sup> Memorandum from Greg LaFlam and Tracy Johnson (PES) to Stephen Shedd (EPA/OAQPS). *Speciated Hazardous Air Pollutants - Baseline Emissions and Emissions Reductions Under the Gasoline Distribution NESHAP*. August 9, 1996.
- <sup>7</sup> Personal Communication via e-mail from Stephen Shedd (EPA/OAQPS) to Laurel Driver (EPA/OAQPS). E-mail dated May 29, 2002.

## COMMERCIAL COOKING

### A. Source Category Description

Commercial cooking refers to the cooking of meat, including steak, hamburger, poultry, pork, and seafood, and french fries on five different cooking devices: chain driven (conveyorized) char-broilers, underfired char-broilers, deep-fat fryers, flat griddles, and clamshell griddles. Estimates of emissions of criteria air pollutants (CAPs) and hazardous air pollutants (HAPs) are based on the average amount of meat cooked on the different equipment types per week. Emissions from french fries are based on the amount of frozen potatoes sold in the US. In 2014, commercial cooking in the US, Puerto Rico, and US Virgin Islands resulted in approximately 15,200 tons of VOC, 34,916 tons of CO, 101,853 tons of primary PM<sub>10</sub>, and 94,511 tons of primary PM<sub>2.5</sub> emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2302002100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Charbroiling	Conveyorized Charbroiling
2302002200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Charbroiling	Under-fired Charbroiling
2302003000	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Frying	Deep Fat Frying
2302003100	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Frying	Flat Griddle Frying
2302003200	Industrial Processes	Food and Kindred Products: SIC 20	Commercial Cooking – Frying	Clamshell Griddle Frying

### B. Overview of Calculations

The calculations for estimating the emissions from commercial cooking involve first estimating the amount of meat and french fries cooked on various cooking devices in each county. These data are estimated using the number of restaurants, by specific restaurant type, from the Dun & Bradstreet (D&B) Hoovers Database<sup>1</sup> and assumptions concerning the percent of those restaurants with specific cooking devices, the number of devices per restaurant, and the amount of meat cooked per device from a California Air Resources Board (CARB) sponsored survey.<sup>2</sup> The amount of french fries cooked by the foodservice industry is from a report prepared for Potatoes USA.<sup>3</sup> The total amount of meat or french fries cooked on each device is multiplied by emissions factors for CAPs including, VOC, CO, PM<sub>10</sub> and PM<sub>2.5</sub>, and various HAPs to estimate emissions of these pollutants from commercial cooking. Sources of data and calculations for the amount of meat cooked on each device are discussed in section C. The process of allocating data on the amount of french fries cooked to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from commercial cooking is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of meat and potatoes cooked on each type of cooking device in each county. These amounts are estimated based on the number of restaurants in a county that use commercial cooking equipment, the percent of restaurants with each type of cooking device, the average number of cooking devices per restaurant, and the average amount of meat or potatoes cooked on each device.

Data concerning the number of restaurants in each county are from the Dun & Bradstreet (D&B) Hoovers Database.<sup>1</sup> Hoovers data are proprietary and were purchased by EPA for use in the NEI; EPA provides users with aggregated data on county level restaurants by type. The relevant restaurants pulled from the Hoovers Database and

their primary SIC codes are listed in Table 1. The first 4 digits of the SIC Code refer to eating places, the last 2 digits are added by D&B to further classify the restaurants.

**Table 1. Hoovers Database Restaurant Types**

Restaurant Type	Primary SIC Code
Ethnic Food	5812-01
Fast Food	5812-03
Family	5812-05
Seafood	5812-07
Steak & BBQ	5812-08

The number of restaurants by type in each county, pulled from the Hoovers database, is then multiplied by the fraction of restaurants by type with commercial cooking equipment in order to calculate the number of restaurants with the specific cooking devices in each county (Table 2). The data on cooking devices and meat cooked are from a survey on charbroiling activity in the state of California.<sup>2</sup>

**Table 2. Percent of Restaurants with Each Type of Cooking Device**

Restaurant Type	Conveyorized Char-broilers	Underfired Char-broilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic	3.5	47.5	81.9	62.7	4.0
Fast Food	18.6	30.8	96.8	51.9	14.7
Family	10.1	60.9	91.4	82.9	1.4
Seafood	0.0	52.6	100.0	36.8	10.5
Steak & BBQ	6.9	55.2	82.8	89.7	0.0

Source: Reference 2, Table 4

$$R_{t,c,d} = R_{t,c} \times \text{Frac}_{t,d} \quad (1)$$

Where:

- $R_{t,c,e}$  = Number of type  $t$  restaurants in county  $c$  with cooking device  $d$
- $R_{t,c}$  = Number of type  $t$  restaurants in county  $c$
- $\text{Frac}_{t,e}$  = Fraction of type  $t$  restaurants with cooking device  $d$

The number of restaurants in each county with cooking devices are then multiplied by the average number of cooking devices by restaurant type (Table 3), from the same California Survey dataset, to calculate the total number of cooking devices.

**Table 3. Average Number of Devices by Restaurant Type\***

Restaurant Type	Conveyorized Char-broilers	Underfired Char-broilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic	1.62	1.54	1.63	1.88	1.80
Fast Food	1.07	1.58	3.10	1.43	2.09
Family	1.71	1.29	2.34	2.03	-
Seafood	-	1.10	2.47	1.11	1.50
Steak & BBQ	-	1.63	2.42	1.35	-

\*Only includes restaurants with at least one piece of the equipment. Source: Reference 2, Table 5.

$$D_{t,c,d} = R_{t,c,d} \times E_{t,d} \quad (2)$$

Where:

- $D_{t,c,d}$  = Total number of cooking device  $d$  in county  $c$  from type  $t$  restaurants
- $R_{t,c,d}$  = Number of type  $t$  restaurants in county  $c$  with cooking device  $d$
- $E_{t,d}$  = Average number of cooking device  $d$  at type  $t$  restaurants

The number of cooking devices in each restaurant type from equation 2 are summed across restaurant types to estimate the total number of cooking devices in each county.

$$D_{c,d} = \sum_t D_{t,c,d} \quad (3)$$

Where:

- $D_{c,d}$  = Total number of cooking devices  $d$  from all restaurants in county  $c$
- $D_{t,c,d}$  = Total number of cooking device  $d$  in restaurant type  $t$  in county  $c$

The total number of cooking devices in each county is used to determine the amount of meat cooked in that county. The average amount of meat cooked on each cooking device is listed in Table 4.

**Table 4. Average Amount of Meat Cooked per Year on Each Cooking Device (tons)**

Meat Type	Conveyorized Char-broilers	Underfired Char-broilers	Deep-Fat Fryers	Flat Griddles	Clamshell Griddles
Steak	6.1	4.7	4.7	4.3	2.4
Hamburger	20.7	7.0	7.1	9.4	34.2
Poultry	10.7	8.4	14.9	5.2	5.7
Pork	1.5	3.8	1.5	2.9	3.1
Seafood	3.1	3.7	4.1	2.4	16.4
Other	-	1.1	7.1	1.5	-

Source: Reference 2, Table 13

$$M_{i,d,c} = D_{c,d} \times m_{i,d} \quad (4)$$

Where:

- $M_{i,d,c}$  = Total amount of meat type  $i$  cooked on device  $d$  in county  $c$ , in tons
- $D_{c,d}$  = Total number of cooking device  $d$  from all restaurants in county  $c$
- $m_{i,d}$  = Average amount of meat type  $i$  cooked on device  $d$ , in tons

The amount of french fries cooked in each county is calculated based on the amount of frozen potatoes used in the foodservice industry. According to a report prepared for Potatoes USA, 5,977 million pounds of frozen potatoes were used in the food service industry in 2017.<sup>3</sup> Frozen potatoes used in limited service restaurants account for approximately 74% of the total, and those used in full service restaurants account for the remaining 26%. The process used to distribute the national amount of french fries cooked to the county-level is discussed in section D.

#### D. Allocation Procedure

In 2017, 5,977 million pounds of frozen potatoes were used in limited and full service restaurants in the U.S.<sup>3</sup> In order to allocate this value to the county-level, fractions of the number of limited and full service restaurants in each county are used. To create these fractions, it is assumed that limited service restaurants are D&B classified fast food restaurants and full services restaurants are represented by all other D&B restaurant codes. County-level fast food and other restaurants are summed, and then divided by the national number of fast food or other restaurants in order to develop the county-level fractions.

$$RFrac_{lim,c} = \frac{R_{lim,c}}{R_{lim,US}} \quad (5)$$

$$RFrac_{full,c} = \frac{R_{full,c}}{R_{full,US}} \quad (6)$$

Where:

- $RFrac_{lim,c}$  = Fraction of limited service restaurants in county  $c$
- $RFrac_{full,c}$  = Fraction of full service restaurants in county  $c$
- $R_{lim,c}$  = The number of limited service restaurants in county  $c$
- $R_{full,c}$  = The number of full service restaurants in county  $c$
- $R_{lim,US}$  = The number of limited service restaurants in the U.S.
- $R_{full,US}$  = The number of full service restaurants in the U.S.

The fraction of limited and full service restaurants in each county is then used to distribute the amount of frozen potatoes cooked. Approximately 4,414 million pounds of frozen potatoes were used in limited service restaurants in the US in 2017 and 1,563 million pounds were used in full service restaurants.<sup>3</sup>

$$F_{lim,c} = RFrac_{lim,c} \times f_{lim,US} \div 2000 \text{ lbs per ton} \quad (7)$$

$$F_{full,c} = RFrac_{full,c} \times f_{full,US} \div 2000 \text{ lbs per ton} \quad (8)$$

Where:

- $F_{lim,c}$  = Amount of french fries cooked in limited service restaurants in county  $c$ , in tons
- $F_{full,c}$  = Amount of french fries cooked in full service restaurants in county  $c$ , in ton
- $RFrac_{lim,c}$  = Fraction of limited service restaurants in county  $c$
- $RFrac_{full,c}$  = Fraction of full service restaurants in county  $c$
- $f_{lim,US}$  = Amount of french fries cooked in limited service restaurants in the U.S., in lbs.
- $f_{full,US}$  = Amount of french fries cooked in full service restaurants in the U.S., in lbs.

The amount of french fries cooked in limited and full service restaurants are then summed to the county level.

$$F_{all,c} = F_{lim,c} + F_{full,c} \quad (9)$$

Where:

- $F_{all,c}$  = Amount of french fries cooked in county  $c$ , in tons
- $F_{lim,c}$  = Amount of french fries cooked in limited service restaurants in county  $c$ , in tons
- $F_{full,c}$  = Amount of french fries cooked in full service restaurants in county  $c$ , in tons

## E. Emissions Factors

Emissions factors for CAPs from commercial cooking are reported in Table 6. CAP emissions factors are taken from the article *Emissions from Charbroiling and Grilling of Chicken and Beef*,<sup>4</sup> and a South Coast Air Quality Management District Report (SCAQMD).<sup>5</sup> According to the most recent PM Augmentation tool, Primary PM is equal to Filterable PM and there are assumed to be no condensible PM emissions from commercial cooking. Emissions factors for HAPs from commercial cooking are reported in Table 7. HAP emissions factors are also from *Emissions from Charbroiling and Grilling of Chicken and Beef*,<sup>4</sup> and an EPA report on emissions from street vendor cooking devices.<sup>6</sup>

## F. Controls

There are no controls assumed for this category.

## G. Emissions

To calculate emissions of CAPs, the total amount of meat and potatoes cooked on each cooking device in each county is multiplied by the appropriate emissions factor (listed in Table 6). The amount of french fries cooked is converted from pounds to tons, and all emissions are converted to tons.

$$E_{p,i,d,c} = M_{i,d,c} \times EF_{p,i,d} \div 2000 \text{ lbs per ton} \quad (10)$$

$$E_{p,f,d,c} = F_{all,c} \times EF_{p,f,d} \div 2000 \text{ lbs per ton} \quad (11)$$

Where:

- $E_{p,i,d,c}$  = Annual emissions of pollutant  $p$  from cooking meat type  $i$  on device  $d$  in county  $c$ , in tons
- $E_{p,f,d,c}$  = Annual emissions of pollutant  $p$  from cooking french fries,  $f$ , on device  $d$  in county  $c$ , in tons
- $M_{i,d,c}$  = Total amount of meat type  $i$  cooked on device  $d$  in county  $c$ , in tons
- $F_{all,c}$  = Total amount of french fries cooked in county  $c$ , in tons
- $EF_{p,i,d}$  = Emissions factor for pollutant  $p$ , in lbs. of pollutant per ton of meat type  $i$  cooked on device  $d$
- $EF_{p,f,d}$  = Emissions factor for pollutant  $p$ , in lbs. of pollutant per ton of french fries cooked on device  $d$

Emissions of HAPs are also calculated by multiplying an emissions factor (Table 7) by the amount of meat cooked on each cooking device. Note that cooking of french fries does not result in HAP emissions. For HAPs, no conversion factor is needed and emissions are reported in pounds.

$$E_{p,i,d,c} = M_{i,d,c} \times EF_{p,i,d} \quad (12)$$

Where:

- $E_{p,i,d,c}$  = Annual emissions of pollutant  $p$  from cooking meat type  $i$  on device  $d$  in county  $c$ , in pounds
- $M_{i,d,c}$  = Total amount of meat type  $i$  cooked on device  $d$  in county  $c$ , in tons
- $EF_{p,i,d}$  = Emissions factor for pollutant  $p$ , in lbs. of pollutant per ton of meat type  $i$  cooked on device  $d$

The emissions are summed for all types of meat and french fries to estimate the total emissions from each cooking device type in each county.

$$E_{p,d,c} = \sum_i E_{p,i,d,c} + E_{p,f,d,c} \quad (13)$$

Where:

- $E_{p,d,c}$  = Total annual emissions of pollutant  $p$  from cooking device  $d$  in county  $c$
- $E_{p,i,d,c}$  = Annual emissions of pollutant  $p$  from cooking meat type  $i$  on device  $d$  in county  $c$
- $E_{p,f,d,c}$  = Annual emissions of pollutant  $p$  from cooking french fries,  $f$ , on device  $d$  in county  $c$

## H. Point Source Subtraction

There are no point source-specific SCCs for commercial cooking; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 5 lists sample calculations to determine the VOC emissions from commercial cooking on flat griddles in Apache County, Arizona. The first two equations use fast food restaurants as an example, and equations 4 and 10 use hamburgers as an example. However, these calculations would need to be repeated to calculate values for all restaurant and meat types.

**Table 5. Sample calculations for VOC emissions from commercial cooking on Flat Griddles in Apache County, AZ.**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$R_{t,c,d} = R_{t,c} \times \text{Frac}_{t,d}$	6 fast food rest. $\times$ 51.9% with flat griddles	3.114 fast food restaurants in Apache County, AZ with flat griddles
2	$D_{t,c,d} = R_{t,c,d} \times E_{t,d}$	3.114 fast food rest. with flat griddles $\times$ 1.43 flat griddles per rest.	4.45 flat griddles in fast food restaurants in Apache County, AZ
3	$D_{c,d} = \sum_t D_{t,c,d}$	$\sum$ Flat griddles in Apache County, AZ	9.5 flat griddles in all restaurants in Apache County, AZ
4	$M_{i,d,c} = D_{c,d} \times m_{i,d}$	9.5 flat griddles in Apache $\times$ 9.4 tons of hamburger cooked on flat griddles	89.3 tons of hamburger cooked on flat griddles in Apache County, AZ
5	$R\text{Frac}_{lim,c} = \frac{R_{lim,c}}{R_{lim,US}}$	N/A	Equation is for deep-fat fryers; example is for flat griddles
6	$R\text{Frac}_{full,c} = \frac{R_{full,c}}{R_{full,US}}$	N/A	Equation is for deep-fat fryers; example is for flat griddles
7	$F_{lim,c} = R\text{Frac}_{lim,c} \times f_{lim,US} \div 2000 \text{ lbs per ton}$	N/A	Equation is for deep-fat fryers; example is for flat griddles
8	$F_{full,c} = R\text{Frac}_{full,c} \times f_{full,US} \div 2000 \text{ lbs per ton}$	N/A	Equation is for deep-fat fryers; example is for flat griddles
9	$F_{all,c} = F_{lim,c} + F_{full,c}$	N/A	Equation is for deep-fat fryers; example is for flat griddles

Eq. #	Equation	Values for Apache County, AZ	Result
10	$E_{p,i,d,c} = M_{i,d,c} \times EF_{p,i,d} \div 2000 \text{ lbs per ton}$	89.3 tons of hamburger cooked $\times 0.14 \text{ lbs.VOC per ton hamburger}$ $\div 2000 \text{ lbs.per ton}$	0.00625 tons VOC emissions from cooking hamburgers on flat griddles in Apache County, AZ
11	$E_{p,f,d,c} = F_{all,c} \times EF_{p,f,d} \div 2000 \text{ lbs per ton}$	N/A	Equation is for deep-fat fryers; example is for flat griddles
12	$E_{p,i,d,c} = M_{i,d,c} \times EF_{p,i,d}$	NA	Equation is for HAPs; example is for VOC
13	$E_{p,d,c} = \sum_i E_{p,i,d,c} + E_{p,f,d,c}$	$\sum \text{VOC emissions in Apache County}$	0.04 tons VOC emissions from flat griddles in Apache County, AZ

## J. Changes from 2014 Methodology

The methodology used to calculate commercial cooking emissions for the 2014 v2 NEI used data on the number of restaurants in each county, according to US NAICS codes, to grow emissions data from the 2002 NEI commercial cooking category. This was completed as EPA did not have access to the more specific D&B data on restaurants in each county. For the 2017 NEI, EPA has access to the D&B data and is therefore using the 2002 NEI methodology (which is also used by the state of California).

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico and the Virgin Islands are calculated using the same methodology described above.

## L. References

- <sup>1</sup> Dun and Bradstreet Hoovers. 2018. <http://www.hoovers.com/>
- <sup>2</sup> Public Research Institute. 2001. *Charbroiling Activity Estimation*. Prepared for the California Air Resources Board and California EPA. <https://www.arb.ca.gov/research/apr/reports/1943.pdf>
- <sup>3</sup> Technomic. 2017. *Volumetric Assessment of the Foodservice Potato Market*. Prepared for Potatoes USA. <http://www.potatoesusa.com/uploads/file-downloads/files/2017-Foodservice-Potato-Volume.pdf>
- <sup>4</sup> McDonald, J., B. Zielinska, E. Fujita, J. Sagebiel, J. Chow, and J. Watson. 2003. "Emissions from Charbroiling and Grilling of Chicken and Beef." *Journal of Air & Waste Management Association*. 53:185-194.
- <sup>5</sup> Norbeck, Joseph. 1997. *Further Development of Emission Test Methods and Development of Emission Factors for Various Commercial Cooking Operations*. Prepared for the South Coast Air Quality Management District.
- <sup>6</sup> US EPA. 1999. *Emissions from Street Vendor Cooking Devices (Charcoal Grilling)*. Prepared by ARCADIS Geraghty & Miller.

**Table 6. Criteria Air Pollutant Emissions Factors for Commercial Cooking**

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Emissions Factor Reference
Conveyorized Char-broilers	Steak	Carbon Monoxide	CO	8.29	mg/kg	16.58	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Volatile Organic Compounds	VOC	2.27	lb./1000 lb.	4.55	lbs./ton	Ref. 5; Table XIII; VOC measured as ROG
		Primary PM10	PM10-PRI	7.40	lb./1000 lb.	14.80	lbs./ton	Ref. 5; Table XIII
		Primary PM2.5	PM25-PRI	7.30	lb./1000 lb.	14.60	lbs./ton	Ref. 5; Table XIII
	Hamburger	Carbon Monoxide	CO	8.29	mg/kg	16.58	lbs./ton	Ref. 4; Table 2
		Volatile Organic Compounds	VOC	2.27	lb./1000 lb.	4.55	lbs./ton	Ref. 5; Table XIII; VOC measured as ROG
		Primary PM10	PM10-PRI	7.40	lb./1000 lb.	14.80	lbs./ton	Ref. 5; Table XIII
		Primary PM2.5	PM25-PRI	7.30	lb./1000 lb.	14.60	lbs./ton	Ref. 5; Table XIII
	Poultry	Carbon Monoxide	CO	4.84	mg/kg	9.68	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Volatile Organic Compounds	VOC	1.82	lb./1000 lb.	3.65	lbs./ton	Ref. 5; Table V; VOC measured as ROG
		Primary PM10	PM10-PRI	10.47	lb./1000 lb.	20.93	lbs./ton	Ref. 5; Table V
		Primary PM2.5	PM25-PRI	9.90	lb./1000 lb.	19.80	lbs./ton	Ref. 5; Table V
	Pork	Carbon Monoxide	CO	4.84	mg/kg	9.68	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Volatile Organic Compounds	VOC	1.82	lb./1000 lb.	3.65	lbs./ton	Ref. 5; Table V; VOC measured as ROG
		Primary PM10	PM10-PRI	10.47	lb./1000 lb.	20.93	lbs./ton	Ref. 5; Table V
		Primary PM2.5	PM25-PRI	9.90	lb./1000 lb.	19.80	lbs./ton	Ref. 5; Table V
Underfired Char-broilers	Steak	Volatile Organic Compounds	VOC	0.38	lb./1000 lb.	0.76	lbs./ton	Ref. 5; Table VI; VOC measured as ROG
		Primary PM10	PM10-PRI	3.27	lb./1000 lb.	6.53	lbs./ton	Ref. 5; Table VI
		Primary PM2.5	PM25-PRI	3.20	lb./1000 lb.	6.40	lbs./ton	Ref. 5; Table VI
		Carbon Monoxide	CO	4.97	mg/kg	9.94	lbs./ton	Ref. 4; Table 2
	Hamburger	Volatile Organic Compounds	VOC	0.86	lb./1000 lb.	1.71	lbs./ton	Ref. 5; Table XVII; VOC measured as ROG
		Primary PM10	PM10-PRI	17.20	lb./1000 lb.	34.40	lbs./ton	Ref. 5; Table XVII
		Primary PM2.5	PM25-PRI	16.80	lb./1000 lb.	33.60	lbs./ton	Ref. 5; Table XVII
		Carbon Monoxide	CO	13.72	mg/kg	27.44	lbs./ton	Ref. 4; Table 2
	Poultry	Volatile Organic Compounds	VOC	3.94	lb./1000 lb.	7.89	lbs./ton	Ref. 5; Table IV; VOC measured as ROG
		Primary PM10	PM10-PRI	32.67	lb./1000 lb.	65.33	lbs./ton	Ref. 5; Table IV
		Primary PM2.5	PM25-PRI	31.90	lb./1000 lb.	63.80	lbs./ton	Ref. 5; Table IV
		Carbon Monoxide	CO	4.84	mg/kg	9.68	lbs./ton	Ref. 4; Table 2
	Pork	Volatile Organic Compounds	VOC	1.82	lb./1000 lb.	3.65	lbs./ton	Ref. 5; Table V; VOC measured as ROG
		Primary PM10	PM10-PRI	10.47	lb./1000 lb.	20.93	lbs./ton	Ref. 5; Table V
		Primary PM2.5	PM25-PRI	9.90	lb./1000 lb.	19.80	lbs./ton	Ref. 5; Table V
		Carbon Monoxide	CO	4.84	mg/kg	9.68	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Emissions Factor Reference
		Volatile Organic Compounds	VOC	1.82	lb./1000 lb.	3.65	lbs./ton	Ref. 5; Table V; VOC measured as ROG
		Primary PM10	PM10-PRI	10.47	lb./1000 lb.	20.93	lbs./ton	Ref. 5; Table V
		Primary PM2.5	PM25-PRI	9.90	lb./1000 lb.	19.80	lbs./ton	Ref. 5; Table V
	Seafood	Volatile Organic Compounds	VOC	0.38	lb./1000 lb.	0.76	lbs./ton	Ref. 5; Table VI; VOC measured as ROG
		Primary PM10	PM10-PRI	3.27	lb./1000 lb.	6.53	lbs./ton	Ref. 5; Table VI
		Primary PM2.5	PM25-PRI	3.20	lb./1000 lb.	6.40	lbs./ton	Ref. 5; Table VI
	Other	Carbon Monoxide	CO	4.97	mg/kg	9.94	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Volatile Organic Compounds	VOC	0.86	lb./1000 lb.	1.71	lbs./ton	Ref. 5; Table XVII; VOC measured as ROG
		Primary PM10	PM10-PRI	17.20	lb./1000 lb.	34.40	lbs./ton	Ref. 5; Table XVII
		Primary PM2.5	PM25-PRI	16.80	lb./1000 lb.	33.60	lbs./ton	Ref. 5; Table XVII
Deep-Fat Fryers	Poultry	Volatile Organic Compounds	VOC	0.12	lb./1000 lb.	0.25	lbs./ton	Ref. 5; Table VIII; VOC measured as ROG
	Pork	Volatile Organic Compounds	VOC	0.12	lb./1000 lb.	0.25	lbs./ton	Ref. 5; Table VIII; VOC measured as ROG
	Seafood	Volatile Organic Compounds	VOC	0.14	lb./1000 lb.	0.28	lbs./ton	Ref. 5; Table IX; VOC measured as ROG
	Potatoes	Volatile Organic Compounds	VOC	0.21	lb./1000 lb.	0.42	lbs./ton	Ref. 5; Table VII; VOC measured as ROG
Flat Griddles	Steak	Carbon Monoxide	CO	0.38	mg/kg	0.76	lbs./ton	Ref. 4; Table 2; Hamburger flat griddle EFs
		Volatile Organic Compounds	VOC	0.07	lb./1000 lb.	0.14	lbs./ton	Ref. 5; Table X; VOC measured as ROG
		Primary PM10	PM10-PRI	5.00	lb./1000 lb.	10.00	lbs./ton	Ref. 5; Table X
		Primary PM2.5	PM25-PRI	3.80	lb./1000 lb.	7.60	lbs./ton	Ref. 5; Table X
	Hamburger	Carbon Monoxide	CO	0.38	mg/kg	0.76	lbs./ton	Ref. 4; Table 2
		Volatile Organic Compounds	VOC	0.07	lb./1000 lb.	0.14	lbs./ton	Ref. 5; Table X; VOC measured as ROG
		Primary PM10	PM10-PRI	5.00	lb./1000 lb.	10.00	lbs./ton	Ref. 5; Table X
		Primary PM2.5	PM25-PRI	3.80	lb./1000 lb.	7.60	lbs./ton	Ref. 5; Table X
	Poultry	Carbon Monoxide	CO	0.45	mg/kg	0.90	lbs./ton	Ref. 4; Table 2
		Volatile Organic Compounds	VOC	0.40	lb./1000 lb.	0.79	lbs./ton	Ref. 5; Table XI; VOC measured as ROG
	Pork	Carbon Monoxide	CO	0.45	mg/kg	0.90	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Volatile Organic Compounds	VOC	0.40	lb./1000 lb.	0.79	lbs./ton	Ref. 5; Table XI; VOC measured as ROG
	Seafood	Volatile Organic Compounds	VOC	0.11	lb./1000 lb.	0.21	lbs./ton	Ref. 5; Table XII; VOC measured as ROG
	Other	Carbon Monoxide	CO	0.38	mg/kg	0.76	lbs./ton	Ref. 4; Table 2; Hamburger flat griddle EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Emissions Factor Reference
		Volatile Organic Compounds	VOC	0.07	lb./1000 lb.	0.14	lbs./ton	Ref. 5; Table X; VOC measured as ROG
		Primary PM10	PM10-PRI	5.00	lb./1000 lb.	10.00	lbs./ton	Ref. 5; Table X
		Primary PM2.5	PM25-PRI	3.80	lb./1000 lb.	7.60	lbs./ton	Ref. 5; Table X
Clamshell Griddles	Steak	Volatile Organic Compounds	VOC	0.01	lb./1000 lb.	0.03	lbs./ton	Ref. 5; Table XVI; VOC measured as ROG
		Primary PM10	PM10-PRI	0.85	lb./1000 lb.	1.70	lbs./ton	Ref. 5; Table XVI
		Primary PM2.5	PM25-PRI	0.72	lb./1000 lb.	1.44	lbs./ton	Ref. 5; Table XVI
	Hamburger	Volatile Organic Compounds	VOC	0.01	lb./1000 lb.	0.03	lbs./ton	Ref. 5; Table XVI; VOC measured as ROG
		Primary PM10	PM10-PRI	0.85	lb./1000 lb.	1.70	lbs./ton	Ref. 5; Table XVI
		Primary PM2.5	PM25-PRI	0.72	lb./1000 lb.	1.44	lbs./ton	Ref. 5; Table XVI
	Poultry	Volatile Organic Compounds	VOC	0.08	lb./1000 lb.	0.15	lbs./ton	Calculated by dividing the Flat Griddle Poultry VOC EF by the ratio of the Flat Griddle to Clamshell Griddle Hamburger VOC EFs
	Pork	Volatile Organic Compounds	VOC	0.08	lb./1000 lb.	0.15	lbs./ton	Calculated by dividing the Flat Griddle Poultry VOC EF by the ratio of the Flat Griddle to Clamshell Griddle Hamburger VOC EFs
	Seafood	Volatile Organic Compounds	VOC	0.02	lb./1000 lb.	0.04	lbs./ton	Calculated by dividing the Flat Griddle Seafood VOC EF by the ratio of the Flat Griddle to Clamshell Griddle Hamburger VOC EFs

ROG = Reactive Organic Gases

**Table 7. Hazardous Air Pollutant Emissions Factors for Commercial Cooking**

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
Conveyorized Char-broilers	Steak	Acenaphthene	83329	0.28	mg/kg	0.00056	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Acenaphthylene	208968	4.89	mg/kg	0.00978	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Anthracene	120127	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Benz[a]anthracene	56553	0.22	mg/kg	0.00044	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Benzo[a]Pyrene	50328	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Benzo[g,h,i]Perylene	191242	0.16	mg/kg	0.00032	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Biphenyl	92524	2.43	mg/kg	0.00486	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Fluoranthene	206440	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Fluorene	86737	1.09	mg/kg	0.00218	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Indeno[1,2,3-c,d]Pyrene	193395	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Naphthalene	91203	23.04	mg/kg	0.04608	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Phenanthrene	85018	4.88	mg/kg	0.00976	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		Pyrene	129000	1.15	mg/kg	0.0023	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
		PAH, Total	130498292	49.05	mg/kg	0.0981	lbs./ton	Ref. 4; Table 2; Hamburger auto-char EFs
	Hamburger	Acenaphthene	83329	0.28	mg/kg	0.00056	lbs./ton	Ref. 4; Table 2
		Acenaphthylene	208968	4.89	mg/kg	0.00978	lbs./ton	Ref. 4; Table 2
		Anthracene	120127	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2
		Benz[a]anthracene	56553	0.22	mg/kg	0.00044	lbs./ton	Ref. 4; Table 2
		Benzo[a]Pyrene	50328	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2
		Benzo[g,h,i]Perylene	191242	0.16	mg/kg	0.00032	lbs./ton	Ref. 4; Table 2
		Biphenyl	92524	2.43	mg/kg	0.00486	lbs./ton	Ref. 4; Table 2
		Fluoranthene	206440	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2
		Fluorene	86737	1.09	mg/kg	0.00218	lbs./ton	Ref. 4; Table 2
		Indeno[1,2,3-c,d]Pyrene	193395	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2
		Naphthalene	91203	23.04	mg/kg	0.04608	lbs./ton	Ref. 4; Table 2
		Phenanthrene	85018	4.88	mg/kg	0.00976	lbs./ton	Ref. 4; Table 2
		Pyrene	129000	1.15	mg/kg	0.0023	lbs./ton	Ref. 4; Table 2
		PAH, Total	130498292	49.05	mg/kg	0.0981	lbs./ton	Ref. 4; Table 2
	Poultry	4-nitrophenol	100027	0.0066	g/kg	0.0132	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Acenaphthene	83329	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acenaphthylene	208968	2.06	mg/kg	0.00412	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acetaldehyde	75070	0.282	g/kg	0.564	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Acetophenone	98862	0.002425	g/kg	0.00485	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Anthracene	120127	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Benz[a]anthracene	56553	0.34	mg/kg	0.00068	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzene	71432	0.504	g/kg	1.008	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Benzo[a]Pyrene	50328	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Biphenyl	92524	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.00511	g/kg	0.01022	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for marinated chicken test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.00128	g/kg	0.00256	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethyl Benzene	100414	0.04	g/kg	0.08	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.014	g/kg	0.028	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Fluorene	86737	0.72	mg/kg	0.00144	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Formaldehyde	50000	0.393	g/kg	0.786	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Naphthalene	91203	8.75	mg/kg	0.0175	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenanthrene	85018	3.46	mg/kg	0.00692	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenol	108952	0.02255	g/kg	0.0451	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0755	g/kg	0.151	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Pyrene	129000	1.8	mg/kg	0.0036	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Styrene	100425	0.1895	g/kg	0.379	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Toluene	108883	0.1995	g/kg	0.399	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		PAH, Total	130498292	28.35	mg/kg	0.0567	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Xylenes (Mixed Isomers)	1330207	0.059	g/kg	0.118	lbs./ton	Ref. 6; Table 3-1; Sum of xylene EFs for marinated chicken test conditions, estimated emissions of meat only
	Pork	4-nitrophenol	100027	0.0066	g/kg	0.0132	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Acenaphthene	83329	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acenaphthylene	208968	2.06	mg/kg	0.00412	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acetaldehyde	75070	0.282	g/kg	0.564	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Acetophenone	98862	0.002425	g/kg	0.00485	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Anthracene	120127	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benz[a]anthracene	56553	0.34	mg/kg	0.00068	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzene	71432	0.504	g/kg	1.008	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Benzo[a]Pyrene	50328	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Biphenyl	92524	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.00511	g/kg	0.01022	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for marinated chicken test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.00128	g/kg	0.00256	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethyl Benzene	100414	0.04	g/kg	0.08	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.014	g/kg	0.028	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Fluorene	86737	0.72	mg/kg	0.00144	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Formaldehyde	50000	0.393	g/kg	0.786	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Naphthalene	91203	8.75	mg/kg	0.0175	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenanthrene	85018	3.46	mg/kg	0.00692	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Phenol	108952	0.02255	g/kg	0.0451	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0755	g/kg	0.151	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Pyrene	129000	1.8	mg/kg	0.0036	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Styrene	100425	0.1895	g/kg	0.379	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Toluene	108883	0.1995	g/kg	0.399	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		PAH, Total	130498292	28.35	mg/kg	0.0567	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Xylenes (Mixed Isomers)	1330207	0.059	g/kg	0.118	lbs./ton	Ref. 6; Table 3-1; Sum of xylene EFs for marinated chicken test conditions, estimated emissions of meat only
Underfired Char-broilers	Steak	Acenaphthene	83329	0.15	mg/kg	0.0003	lbs./ton	Ref. 4; Table 2
		Acenaphthylene	208968	4.28	mg/kg	0.00856	lbs./ton	Ref. 4; Table 2
		Acetaldehyde	75070	0.251	g/kg	0.502	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Acetophenone	98862	0.001829	g/kg	0.003658	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only
		Anthracene	120127	1.03	mg/kg	0.00206	lbs./ton	Ref. 4; Table 2
		Benzene	71432	0.3915	g/kg	0.783	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Benz[a]anthracene	56553	0.11	mg/kg	0.00022	lbs./ton	Ref. 4; Table 2
		Benzo[a]Pyrene	50328	0.07	mg/kg	0.00014	lbs./ton	Ref. 4; Table 2
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2
		Biphenyl	92524	1.54	mg/kg	0.00308	lbs./ton	Ref. 4; Table 2
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.0026825	g/kg	0.005365	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for beef test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.0010255	g/kg	0.002051	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only
		Ethyl Benzene	100414	0.026	g/kg	0.052	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.0165	g/kg	0.033	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2
		Fluorene	86737	1.17	mg/kg	0.00234	lbs./ton	Ref. 4; Table 2

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Formaldehyde	50000	0.337	g/kg	0.674	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.05	mg/kg	0.0001	lbs./ton	Ref. 4; Table 2
		Naphthalene	91203	14.8	mg/kg	0.0296	lbs./ton	Ref. 4; Table 2
		Phenanthrene	85018	5.31	mg/kg	0.01062	lbs./ton	Ref. 4; Table 2
		Phenol	108952	0.01605	g/kg	0.0321	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0675	g/kg	0.135	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Pyrene	129000	1.56	mg/kg	0.00312	lbs./ton	Ref. 4; Table 2
		Styrene	100425	0.151	g/kg	0.302	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Toluene	108883	0.1535	g/kg	0.307	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		PAH, Total	130498292	39.12	mg/kg	0.07824	lbs./ton	Ref. 4; Table 2
		Xylenes (Mixed Isomers)	1330207	0.045	g/kg	0.09	lbs./ton	Ref. 6; Table 3-3; Sum of xylene EFs for beef test conditions, estimated emissions of meat only
	Hamburger	Acenaphthene	83329	0.15	mg/kg	0.0003	lbs./ton	Ref. 4; Table 2
		Acenaphthylene	208968	4.24	mg/kg	0.00848	lbs./ton	Ref. 4; Table 2
		Anthracene	120127	0.94	mg/kg	0.00188	lbs./ton	Ref. 4; Table 2
		Benz[a]anthracene	56553	0.22	mg/kg	0.00044	lbs./ton	Ref. 4; Table 2
		Benzo[a]Pyrene	50328	0.15	mg/kg	0.0003	lbs./ton	Ref. 4; Table 2
		Benzo[g,h,i]Perylene	191242	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2
		Biphenyl	92524	1.72	mg/kg	0.00344	lbs./ton	Ref. 4; Table 2
		Fluoranthene	206440	1.4	mg/kg	0.0028	lbs./ton	Ref. 4; Table 2
		Fluorene	86737	1.26	mg/kg	0.00252	lbs./ton	Ref. 4; Table 2
		Indeno[1,2,3-c,d]Pyrene	193395	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2
		Naphthalene	91203	19.11	mg/kg	0.03822	lbs./ton	Ref. 4; Table 2
		Phenanthrene	85018	4.88	mg/kg	0.00976	lbs./ton	Ref. 4; Table 2
		PAH, Total	130498292	45.6	mg/kg	0.0912	lbs./ton	Ref. 4; Table 2
		Pyrene	129000	1.9	mg/kg	0.0038	lbs./ton	Ref. 4; Table 2
	Poultry	4-nitrophenol	100027	0.0066	g/kg	0.0132	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Acenaphthene	83329	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acenaphthylene	208968	2.06	mg/kg	0.00412	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acetaldehyde	75070	0.282	g/kg	0.564	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Acetophenone	98862	0.002425	g/kg	0.00485	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Anthracene	120127	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benz[a]anthracene	56553	0.34	mg/kg	0.00068	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzene	71432	0.504	g/kg	1.008	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Benzo[a]Pyrene	50328	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Biphenyl	92524	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.00511	g/kg	0.01022	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for marinated chicken test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.00128	g/kg	0.00256	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethyl Benzene	100414	0.04	g/kg	0.08	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.014	g/kg	0.028	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Fluorene	86737	0.72	mg/kg	0.00144	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Formaldehyde	50000	0.393	g/kg	0.786	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Naphthalene	91203	8.75	mg/kg	0.0175	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenanthrene	85018	3.46	mg/kg	0.00692	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenol	108952	0.02255	g/kg	0.0451	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0755	g/kg	0.151	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Pyrene	129000	1.8	mg/kg	0.0036	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Styrene	100425	0.1895	g/kg	0.379	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Toluene	108883	0.1995	g/kg	0.399	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		PAH, Total	130498292	28.35	mg/kg	0.0567	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Xylenes (Mixed Isomers)	1330207	0.059	g/kg	0.118	lbs./ton	Ref. 6; Table 3-1; Sum of xylene EFs for marinated chicken test conditions, estimated emissions of meat only
	Pork	4-nitrophenol	100027	0.0066	g/kg	0.0132	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Acenaphthene	83329	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acenaphthylene	208968	2.06	mg/kg	0.00412	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Acetaldehyde	75070	0.282	g/kg	0.564	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Acetophenone	98862	0.002425	g/kg	0.00485	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Anthracene	120127	0.88	mg/kg	0.00176	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benz[a]anthracene	56553	0.34	mg/kg	0.00068	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzene	71432	0.504	g/kg	1.008	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Benzo[a]Pyrene	50328	0.1	mg/kg	0.0002	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Biphenyl	92524	0.91	mg/kg	0.00182	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.00511	g/kg	0.01022	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for marinated chicken test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.00128	g/kg	0.00256	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethyl Benzene	100414	0.04	g/kg	0.08	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.014	g/kg	0.028	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Fluorene	86737	0.72	mg/kg	0.00144	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Formaldehyde	50000	0.393	g/kg	0.786	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Naphthalene	91203	8.75	mg/kg	0.0175	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenanthrene	85018	3.46	mg/kg	0.00692	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Phenol	108952	0.02255	g/kg	0.0451	lbs./ton	Ref. 6; Table 3-3; Average of marinated chicken test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0755	g/kg	0.151	lbs./ton	Ref. 6; Table 3-4; Average of marinated chicken test conditions, estimated emissions of meat only
		Pyrene	129000	1.8	mg/kg	0.0036	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Styrene	100425	0.1895	g/kg	0.379	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		Toluene	108883	0.1995	g/kg	0.399	lbs./ton	Ref. 6; Table 3-1; Average of marinated chicken test conditions, estimated emissions of meat only
		PAH, Total	130498292	28.35	mg/kg	0.0567	lbs./ton	Ref. 4; Table 2; Chicken under-char EFs
		Xylenes (Mixed Isomers)	1330207	0.059	g/kg	0.118	lbs./ton	Ref. 6; Table 3-1; Sum of xylene EFs for marinated chicken test conditions, estimated emissions of meat only
	Other	Acenaphthene	83329	0.15	mg/kg	0.0003	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Acenaphthylene	208968	4.28	mg/kg	0.00856	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Acetaldehyde	75070	0.251	g/kg	0.502	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Acetophenone	98862	0.001829	g/kg	0.003658	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only
		Anthracene	120127	1.03	mg/kg	0.00206	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Benzene	71432	0.3915	g/kg	0.783	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Benz[a]anthracene	56553	0.11	mg/kg	0.00022	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Benzo[a]Pyrene	50328	0.07	mg/kg	0.00014	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Benzo[g,h,i]Perylene	191242	0.09	mg/kg	0.00018	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Biphenyl	92524	1.54	mg/kg	0.00308	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Cresol/Cresylic Acid (Mixed Isomers)	1319773	0.0026825	g/kg	0.005365	lbs./ton	Ref. 6; Table 3-3; Sum of cresol EFs for beef test conditions, estimated emissions of meat only
		Dibutyl Phthalate	84742	0.0010255	g/kg	0.002051	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Ethyl Benzene	100414	0.026	g/kg	0.052	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Ethylene Dichloride	107062	0.0165	g/kg	0.033	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Fluoranthene	206440	1.28	mg/kg	0.00256	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Fluorene	86737	1.17	mg/kg	0.00234	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Formaldehyde	50000	0.337	g/kg	0.674	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Indeno[1,2,3-c,d]Pyrene	193395	0.05	mg/kg	0.0001	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Naphthalene	91203	14.8	mg/kg	0.0296	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Phenanthrene	85018	5.31	mg/kg	0.01062	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Phenol	108952	0.01605	g/kg	0.0321	lbs./ton	Ref. 6; Table 3-3; Average of beef test conditions, estimated emissions of meat only
		Propionaldehyde	123386	0.0675	g/kg	0.135	lbs./ton	Ref. 6; Table 3-4; Average of beef test conditions, estimated emissions of meat only
		Pyrene	129000	1.56	mg/kg	0.00312	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Styrene	100425	0.151	g/kg	0.302	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		Toluene	108883	0.1535	g/kg	0.307	lbs./ton	Ref. 6; Table 3-1; Average of beef test conditions, estimated emissions of meat only
		PAH, Total	130498292	39.12	mg/kg	0.07824	lbs./ton	Ref. 4; Table 2; Steak under-char EFs
		Xylenes (Mixed Isomers)	1330207	0.045	g/kg	0.09	lbs./ton	Ref. 6; Table 3-3; Sum of xylene EFs for beef test conditions, estimated emissions of meat only
Flat Griddles	Steak	Acenaphthene	83329	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Acenaphthylene	208968	0.16	mg/kg	0.00032	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Anthracene	120127	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Benz[a]anthracene	56553	0.07	mg/kg	0.00014	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Benzo[a]Pyrene	50328	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Biphenyl	92524	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Fluoranthene	206440	0.86	mg/kg	0.00172	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Fluorene	86737	0.21	mg/kg	0.00042	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Naphthalene	91203	0.61	mg/kg	0.00122	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Phenanthrene	85018	2.07	mg/kg	0.00414	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Pyrene	129000	1.15	mg/kg	0.0023	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		PAH, Total	130498292	7.96	mg/kg	0.01592	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
	Hamburger	Acenaphthene	83329	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2
		Acenaphthylene	208968	0.16	mg/kg	0.00032	lbs./ton	Ref. 4; Table 2
		Anthracene	120127	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2
		Benz[a]anthracene	56553	0.07	mg/kg	0.00014	lbs./ton	Ref. 4; Table 2
		Benzo[a]Pyrene	50328	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2

Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Biphenyl	92524	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2
		Fluoranthene	206440	0.86	mg/kg	0.00172	lbs./ton	Ref. 4; Table 2
		Fluorene	86737	0.21	mg/kg	0.00042	lbs./ton	Ref. 4; Table 2
		Naphthalene	91203	0.61	mg/kg	0.00122	lbs./ton	Ref. 4; Table 2
		Phenanthrene	85018	2.07	mg/kg	0.00414	lbs./ton	Ref. 4; Table 2
		Pyrene	129000	1.15	mg/kg	0.0023	lbs./ton	Ref. 4; Table 2
		PAH, Total	130498292	7.96	mg/kg	0.01592	lbs./ton	Ref. 4; Table 2
	Poultry	Acenaphthene	83329	0.05	mg/kg	0.0001	lbs./ton	Ref. 4; Table 2
		Acenaphthylene	208968	0.13	mg/kg	0.00026	lbs./ton	Ref. 4; Table 2
		Anthracene	120127	0.44	mg/kg	0.00088	lbs./ton	Ref. 4; Table 2
		Benz[a]anthracene	56553	0.12	mg/kg	0.00024	lbs./ton	Ref. 4; Table 2
		Benzo[a]Pyrene	50328	0.01	mg/kg	0.00002	lbs./ton	Ref. 4; Table 2
		Biphenyl	92524	0.13	mg/kg	0.00026	lbs./ton	Ref. 4; Table 2
		Fluoranthene	206440	0.62	mg/kg	0.00124	lbs./ton	Ref. 4; Table 2
		Fluorene	86737	0.18	mg/kg	0.00036	lbs./ton	Ref. 4; Table 2
		Naphthalene	91203	1	mg/kg	0.002	lbs./ton	Ref. 4; Table 2
		Phenanthrene	85018	1.87	mg/kg	0.00374	lbs./ton	Ref. 4; Table 2
		Pyrene	129000	0.82	mg/kg	0.00164	lbs./ton	Ref. 4; Table 2
		PAH, Total	130498292	9.51	mg/kg	0.01902	lbs./ton	Ref. 4; Table 2
	Pork	Acenaphthene	83329	0.05	mg/kg	0.0001	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Acenaphthylene	208968	0.13	mg/kg	0.00026	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Anthracene	120127	0.44	mg/kg	0.00088	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Benz[a]anthracene	56553	0.12	mg/kg	0.00024	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Benzo[a]Pyrene	50328	0.01	mg/kg	0.00002	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Benzo[g,h,i]Perylene	191242	0	mg/kg	0	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Biphenyl	92524	0.13	mg/kg	0.00026	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Fluoranthene	206440	0.62	mg/kg	0.00124	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Fluorene	86737	0.18	mg/kg	0.00036	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Indeno[1,2,3-c,d]Pyrene	193395	0	mg/kg	0	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Naphthalene	91203	1	mg/kg	0.002	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Phenanthrene	85018	1.87	mg/kg	0.00374	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		Pyrene	129000	0.82	mg/kg	0.00164	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
		PAH, Total	130498292	9.51	mg/kg	0.01902	lbs./ton	Ref. 4; Table 2; Chicken griddle EFs
	Other	Acenaphthene	83329	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Acenaphthylene	208968	0.16	mg/kg	0.00032	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Anthracene	120127	0.17	mg/kg	0.00034	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Benz[a]anthracene	56553	0.07	mg/kg	0.00014	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Benzo[a]Pyrene	50328	0.02	mg/kg	0.00004	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Biphenyl	92524	0.06	mg/kg	0.00012	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Fluoranthene	206440	0.86	mg/kg	0.00172	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
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Cooking Device	Meat	Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
		Naphthalene	91203	0.61	mg/kg	0.00122	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Phenanthrene	85018	2.07	mg/kg	0.00414	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		Pyrene	129000	1.15	mg/kg	0.0023	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs
		PAH, Total	130498292	7.96	mg/kg	0.01592	lbs./ton	Ref. 4; Table 2; Hamburger griddle EFs

## GREENWASTE COMPOSTING

### A. Source Category Description

Greenwaste composting includes the diversion of yard waste, food waste, and other biogenic waste from landfills to composting facilities. Estimates of emissions of volatile organic compounds (VOC), ammonia (NH<sub>3</sub>), and three hazardous air pollutants (HAPs), acetaldehyde; methanol; and naphthalene, from greenwaste composting are based on the amount of food and yard waste composted. Composting of biogenic waste is currently not included in emissions estimates for this category as activity data on this waste type is not available. In 2014, greenwaste composting in the US, Puerto Rico, and US Virgin Islands resulted in approximately 6,948 tons of NH<sub>3</sub> and 49,162 tons of VOC emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2680003000	Waste Disposal, Treatment, and Recovery	Composting	Greenwaste	All Processes

Note that this source category does not include the composting of biosolids from wastewater treatment plants or manure management facilities. There are separate SCCs for biosolids (2680001000) and for a mixture of greenwaste and biosolids (2680002000). EPA is not currently estimating emissions for these SCCs. If S/L/Ts report any emissions for the mixture SCC, emissions from the greenwaste portion of that mixture may be duplicative of some or all of the EPA emissions estimates described here. Note also that this source category estimates emissions from composting facilities but does not estimate emissions from backyard composting.

### B. Overview of Calculations

The calculations for estimating the emissions from greenwaste composting involve first estimating the amount of food and yard waste composted in each county. The amount of state-level food waste composted is available from the EPA report *Food Waste Management in the United States, 2014*. The amount of state-level yard waste composted is estimated by calculating the per-capita amount of yard waste composted using national data from the EPA report *Advancing Sustainable Materials Management: 2014 Fact Sheet*, and multiplying that by the state population. The state-level yard and food waste are summed together and distributed to the counties based on the proportion of employment at solid waste landfills. The total amount of greenwaste composted is multiplied by emissions factors for VOC and NH<sub>3</sub> to estimate emissions of these pollutants from greenwaste composting. Sources of data and calculations for the amount of food and yard waste composted are discussed in section C. The process of allocating food and yard waste activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from greenwaste composting is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of food and yard waste composted, which is estimated using data from two EPA reports: the national-level amount of yard waste composted comes from *Advancing Sustainable Materials Management: 2014 Fact Sheet* and the state-level amount of food waste composted comes from *Food Waste Management in the United States, 2014*.<sup>1,2</sup>

Table 1 shows the total national-level amount of yard waste generated and recovered for composting.

**Table 1. Annual Waste Generated and Recovered in the US in 2014**

Material	Waste Generated (million tons)	Waste Recovered (million tons)
Yard trimmings	34.50	21.08

Source: Reference 1, Table 1

The values from Table 1 are used with the U.S. population in 2014 of 319 million people<sup>3</sup> to determine per-capita values of food and yard waste recovered for composting.

$$PC_{yard,US} = \frac{W_{yard,US}}{P_{US}} \quad (1)$$

Where:

$PC_{yard,US}$  = Per-capita yard waste recovered for composting in the US, in tons per person per year  
 $W_{yard,US}$  = Total annual yard waste recovered in the US, in tons/year  
 $P_{US}$  = US population

This calculation results in per-capita values of approximately 0.066 tons per person per year of yard waste recovered for composting. Please note that EPA data on composting does not include backyard composting.

The per-capita yard waste values from equation 1 are multiplied by the population of each state to estimate the state-level amount of yard waste recovered for composting.

$$W_{yard,s} = PC_{yard,US} \times P_s \quad (2)$$

Where:

$W_{yard,s}$  = Annual yard waste recovered for composting in state  $s$ , in tons  
 $PC_{yard,US}$  = Per-capita yard waste recovered for composting in the US, in tons per person per year  
 $P_s$  = Population of state  $s$

EPA reports the amount of food waste composted at the state level in the report *Food Waste Management in the United States, 2014*.<sup>2</sup> These values are shown in Table 2. EPA collected these data from state environmental websites and contacts with state agencies. The data year for each state is listed, and represents the latest data available. The data were not altered from the original reference for use in this methodology.

**Table 2. State-level food waste composting.**

State	Food Composted (tons)	Data Year	State	Food Composted (tons)	Data Year
California	715,119	2012	Nevada	35,869	2014
Colorado	29,130	2013	New Hampshire	110	2012
Connecticut	4,644	2013	New Jersey	28,634	2012
Delaware	17,626	2013	New York	44,405	2013
Florida	158,711	2014	North Carolina	38,014	2014
Georgia	8,021	2014	Ohio	81,450	2014
Hawaii	39,287	2014	Oregon	50,143	2013
Indiana	13,525	2013	Pennsylvania	56,851	2013
Iowa	4,334	2010	Rhode Island	150	2014
Kansas	1,127	2010	South Carolina	4,277	2014
Maine	1,658	2010	Tennessee	1,500	2013
Maryland	69,643	2014	Texas	188	2012
Massachusetts	2,753	2014	Vermont	14,738	2013
Michigan	8,700	2013	Virginia	2,454	2014
Minnesota	46,751	2013	Washington	65,221	2013

State	Food Composted (tons)	Data Year
Mississippi	242	2013
Missouri	16,000	2014

State	Food Composted (tons)	Data Year
Wisconsin	8,677	2013
<b>Total</b>	<b>1,569,952</b>	

Source: Reference 2, Table 3.

The state-level amount of total greenwaste composted is the sum of the state-level food and yard waste composted.

$$W_{GW,s} = W_{yard,s} + W_{food,s} \quad (3)$$

Where:

- $W_{GW,s}$  = Annual total greenwaste recovered for composting in state  $s$ , in tons
- $W_{yard,s}$  = Annual yard waste recovered for composting in state  $s$ , in tons
- $W_{food,s}$  = Annual food waste recovered for composting in state  $s$ , in tons, from Table 2

The process used to distribute the state-level amount of greenwaste composted to the counties is discussed in section D.

#### D. Allocation Procedure

Comprehensive data on the county locations of composting facilities is not available. As a result, the analysis assumes that greenwaste composting facilities are co-located with solid waste landfills.

State-level food greenwaste composting activity (from equation 3) is allocated to the county-level using employment at solid waste landfills (NAICS code 562212). Specifically, state-level estimates of greenwaste collected for composting are multiplied by the ratio of county- to state- level number of employees at landfills.

$$EmpFrac_c = \frac{Emp_c}{Emp_s} \quad (4)$$

Where:

- $EmpFrac_c$  = The fraction of landfill employees in county  $c$
- $Emp_c$  = The number of landfill employees in county  $c$
- $Emp_s$  = The number of landfill employees in state  $s$

Employment data are from the U.S. Census Bureau's 2014 County Business Patterns (CBP).<sup>4</sup> Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one solid waste landfill, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 562212.

To gap-fill withheld state-level employment data:

- a. State-level data for states with known employment in NAICS 562212 are summed to the national level.
- b. The total sum of state-level known employment from step a is subtracted from the national total reported employment for NAICS 562212 in the national-level CBP to determine the employment total for the withheld states.
- c. Each of the withheld states is assigned the midpoint of the range code reported for that state. Table 3 lists the range codes and midpoints.
- d. The midpoints for the states with withheld data are summed to the national-level.

- e. An adjustment factor is created by dividing the number of withheld employees (calculated in step b of this section) by the sum of the midpoints (step d).
- f. For the states with withheld employment data, the midpoint of the range for that state (step c) is multiplied by the adjustment factor (step e) to calculate the adjusted state-level employment for landfills.

These same steps are then followed to fill in withheld data in the county-level business patterns.

- g. County-level data for counties with known employment are summed by state.
- h. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
- i. Each of the withheld counties is assigned the midpoint of the range code (Table 3).
- j. The midpoints for the counties with withheld data are summed to the state level.
- k. An adjustment factor is created by dividing the number of withheld employees (step h) by the sum of the midpoints (step j).
- l. For counties with withheld employment data, the midpoints (step i) are multiplied by the adjustment factor (step k) to calculate the adjusted county-level employment for landfills.

**Table 3. Ranges and midpoints for data withheld from state and county business patterns**

Employment Code	Ranges	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2014 CBP data for NAICS 562212 (Landfills) in Arizona provided in Table 4.

**Table 4. 2014 County Business Pattern for NAICS 562212 in Arizona**

State FIPS	County FIPS	County Name	NAICS	Employment Code	Employment
04	001	Apache	562212	B	withheld
04	007	Gila	562212	A	withheld
04	012	La Paz	562212	A	withheld
04	013	Maricopa	562212		234
04	015	Mohave	562212	B	withheld
04	017	Navajo	562212	A	withheld
04	021	Pinal	562212		72
04	023	Santa Cruz	562212	A	withheld
04	025	Yavapai	562212	A	withheld
04	027	Yuma	562212	B	withheld

*Note:* Counties in Arizona that do not have employment in solid waste landfills are excluded from this table.

1. The total number of known county-level employees in Arizona is 306.

2. The state-level CBP reports 425 employees for NAICS 562212 in Arizona. This means there are 119 employees total for the 8 counties for which data are withheld.
3. The counties with withheld data are assigned midpoints according to their employment code in Table 3. For example, Apache County is given a midpoint of 60 employees (since range code B is 20-99) and Gila County is given a midpoint of 10 employees.
4. The state total of the midpoints for all withheld counties is 230 employees.
5. The adjustment factor is  $119/230 = 0.5174$ .
6. The adjusted employment for Apache County is  $60 \times 0.5174 = 31$ . Gila County has an adjusted employment of  $10 \times 0.5174 = 5$  employees.

Once county- and state-level employment have been estimated, the ratio of county to state employees (from equation 4) is calculated and multiplied by the state-level greenwaste recovered for composting (from equation 3) to calculate the amount of waste composted in each county.

$$W_{GW,c} = EmpFrac_c \times W_{GW,s} \quad (5)$$

Where:

$$\begin{aligned} W_{GW,c} &= \text{Annual total greenwaste composted in county } c, \text{ in tons} \\ W_{GW,s} &= \text{Annual total greenwaste recovered for composting in state } s, \text{ in tons} \\ EmpFrac_c &= \text{The fraction of landfill employees in county } c \end{aligned}$$

## E. Emissions Factors

Emissions factors for greenwaste composting are reported in Table 5. The emissions factors for VOC and ammonia (NH3) are taken from the California Air Resources Board Emissions Inventory Methodology for Composting Facilities,<sup>5</sup> and are unaltered from the original reference. The emissions factors for the HAPs (acetaldehyde, methanol, and naphthalene) are taken from Kumar et al.<sup>6</sup>

Table 5. Emissions Factors for Composting of Greenwaste (2680003000)

Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units	Emissions Factor Reference
VOC	VOC	4.67	lbs./ton compost	5
Ammonia	NH3	0.66		
Acetaldehyde	75070	0.0014	lbs./lbs. VOC	6
Methanol	67561	0.1279		
Naphthalene	91203	0.005		

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The total annual greenwaste composted in each county is multiplied by the emissions factors in Table 5 to estimate emissions. For VOC and NH3, the emissions are multiplied by a conversion factor to convert from pounds to tons.

$$E_{p,c} = W_{GW,c} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lbs.}} \quad (6)$$

Where:

$E_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$ , in tons for VOC and NH3 and lbs. for HAPs  
 $W_{GW,c}$  = Annual total greenwaste recovered for composting in state  $s$ , in tons  
 $EF_p$  = Emissions factor for pollutant  $p$ , in tons of pollutant per ton of greenwaste composted

Emissions of HAPs are estimated by applying speciation factors found in Table 5 to annual VOC emissions. For HAPS, no conversion factor is needed and the emissions are reported in tons.

$$E_{h,c} = E_{VOC,c} \times SF_h \quad (7)$$

Where:

$E_{h,c}$  = Annual emissions of HAP  $h$  in county  $c$ , in tons per year  
 $E_{VOC,c}$  = Annual VOC emissions in county  $c$ , in tons  
 $SF_h$  = Speciation factor for HAP  $h$ , in tons of HAP emissions per ton of VOC emissions

## H. Point Source Subtraction

There are no point source-specific SCCs for composting; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 6 lists sample calculations to determine the VOC emissions from composting of greenwaste in Apache County, Arizona.

**Table 6. Sample calculations for VOC emissions from greenwaste composting in Apache County, AZ.**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$PC_{yard,US} = \frac{W_{yard,US}}{P_{US}}$	$\frac{21.08 \text{ million tons yard waste}}{319 \text{ million people}}$	0.066 tons yard waste per person per year
2	$W_{yard,s} = PC_{yard,US} \times P_s$	$0.066 \text{ tons yard waste per person} \times 6,719,993 \text{ people in AZ}$	443,520 tons yard waste composted in AZ
3	$W_{GW,s} = W_{yard,s} + W_{food,s}$	$443,520 \text{ tons yard waste} + 0 \text{ tons food waste}$	443,520 tons greenwaste composted in AZ
4	$EmpFrac_c = \frac{Emp_c}{Emp_s}$	$\frac{31 \text{ employees in Apache County}}{425 \text{ employees in AZ}}$	0.073 fraction of solid waste employees in Apache County, AZ
5	$W_{GW,c} = EmpFrac_c \times W_{GW,s}$	$0.073 \text{ fraction} \times 443,520 \text{ tons greenwaste composted}$	32,351 tons greenwaste composted in Apache County, AZ
6	$E_{p,c} = W_{GW,c} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lbs.}}$	$32,351 \text{ tons greenwaste} \times 4.67 \text{ lbs. VOC per ton greenwaste} \times \frac{1 \text{ ton}}{2000 \text{ lbs.}}$	75 tons VOC emissions from greenwaste composting in Apache County, AZ

## J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data,<sup>7</sup> since 2014 Census Data does not exist for the U.S. Virgin Islands.

## L. References

- <sup>1</sup> U.S. EPA, *Advancing Sustainable Materials Management: Facts and Figures Report*, Table 1. Generation, Recovery, and Discards of Products in MSW, 2014. <http://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report>
- <sup>2</sup> U.S. EPA. 2016. *Food Waste Management in the United States, 2014*. Office of Resource Conservation and Recovery. [https://www.epa.gov/sites/production/files/2016-12/documents/food\\_waste\\_management\\_2014\\_12082016\\_508.pdf](https://www.epa.gov/sites/production/files/2016-12/documents/food_waste_management_2014_12082016_508.pdf)
- <sup>3</sup> U.S. Census Bureau. *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2014 Populations Estimates*, [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP\\_2014\\_PEPANNRES&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2014_PEPANNRES&prodType=table)
- <sup>4</sup> U.S. Census Bureau. *2014 County Business Patterns*, <http://www.census.gov/data/datasets/2014/econ/cbp/2014-cbp.html>
- <sup>5</sup> California Air Resources Board. 2015. ARB Emissions Inventory Methodology for Composting Facilities. Table A-4. <https://www.arb.ca.gov/ei/areasrc/Composting%20Emissions%20Inventory%20Methodology%20Final%20Combined.pdf>. Emission factor data taken from Draft Staff Report on Proposed Amended Rule 1133.1 (chipping and grinding activities) and Proposed Rule 1133.3 (emissions reductions from greenwaste composting operations), Table III-3, [http://www.healthysoil.org/images/4-PAR1133.1\\_PR1133.3\\_FullDraftSR.pdf](http://www.healthysoil.org/images/4-PAR1133.1_PR1133.3_FullDraftSR.pdf)
- <sup>6</sup> Kumar, A., C.P. Alaimo, R. Horowitz, F.M. Mitloehner, M.J. Kleeman, and P.G. Green. 2011. Volatile organic compound emissions from green waste composting: Characterization and ozone formation. *Atmospheric Environment*, 45:1841-1848.
- <sup>7</sup> U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1, [http://www2.census.gov/census\\_2010/04-Summary\\_File\\_1/](http://www2.census.gov/census_2010/04-Summary_File_1/).

## CONSTRUCTION DUST – NON-RESIDENTIAL CONSTRUCTION

### A. Source Category Description

Emissions from this source category include dust emissions from non-residential construction. Estimates of emissions of particulate matter less than 10 µm in diameter (PM10) and less than 2.5 µm in diameter (PM25) from non-residential construction are based on the acreage disturbed for construction activities. In 2014, non-residential construction resulted in approximately 986,889 tons of PM10-PRI and 98,689 tons of PM25-PRI emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2311020000	Industrial Processes	Construction: SIC 15 - 17	Industrial/ Commercial/Institutional	Total

### B. Overview of Calculations

The calculations for estimating the emissions from non-residential construction involve first estimating the acres disturbed from non-residential construction in each county. The value of national-level non-residential construction spending is available from the U.S. Census Bureau and is converted to acreage disturbed using a conversion factor from a report by the Midwest Research Institute (MRI). The national-level acres disturbed are distributed to counties based on the proportion of non-residential construction employment in each county. Emissions factors for PM10 and PM25 are calculated based on precipitation-evaporation values and dry silt content in each county. The total amount of acres disturbed is multiplied by these emissions factors to estimate emissions of PM from non-residential construction. Sources of data and calculations for the amount of non-residential construction are discussed in section C. The process of allocating non-residential construction activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from non-residential construction is discussed in section G.

### C. Activity Data

The activity data for this source category is the acreage disturbed from non-residential construction, which is estimated using data from the U.S. Census Bureau's *Annual Value of Construction Put in Place in the U.S.*<sup>1</sup> and a conversion factor from MRI's *Estimating Particulate Matter Emissions from Construction Operations, Final Report*.<sup>2</sup> The national-level non-residential construction spending data are allocated to the county-level based on the proportion of non-residential construction employees (NAICS 2362) in each county. Employment data are taken from the U.S. Census Bureau's 2014 County Business Patterns (CBP), and gaps in employment data are filled using a process described in detail in section D.

$$EmpFr_c = \frac{Emp_c}{Emp_{US}} \quad (1)$$

$$CS_c = EmpFr_c \times CS_{US} \quad (2)$$

Where:

- $EmpFr_c$  = The fraction of non-residential construction employees in county  $c$
- $Emp_c$  = The number of non-residential construction employees in county  $c$
- $Emp_{US}$  = The number of non-residential construction employees in the US
- $CS_c$  = Non-residential construction spending in county  $c$
- $CS_{US}$  = Non-residential construction spending in the US

Non-residential construction spending is converted to acres disturbed using a conversion factor from MRI's report. For the average acres disturbed per million dollars of non-residential construction, MRI reported a conversion factor of 2 acres/\$1 million (in 1992 constant dollars). The 1992 conversion factor is adjusted to 2017 using the *Price Deflator (Fisher) Index of New Single-Family Houses under Construction*.<sup>3</sup> In 2014 the conversion factor was 1.009

acres per million dollars spent on non-residential construction activities.

$$Apd_{2017} = \frac{2 \text{ acres}}{\$1 \text{ million}} \times \frac{PD_{1992}}{PD_{2017}} \quad (3)$$

Where:

$Apd_{2017}$  = Acres disturbed per million dollars in 2017  
 $PD_{1992}$  = Price Deflator (Fisher) Index value in 1992  
 $PD_{2017}$  = Price Deflator (Fisher) Index value in 2017

County-level non-residential construction spending (from equation 2) is then multiplied by this conversion factor to estimate county-level acreage disturbed from non-residential construction activities.

$$A_c = CS_c \times Apd_{2017} \quad (4)$$

Where:

$A_c$  = Acres disturbed from non-residential construction in county  $c$   
 $CS_c$  = Non-residential construction spending in county  $c$   
 $Apd_{2017}$  = Acres disturbed per million dollars in 2017

#### D. Allocation Procedure

Employment data are obtained from the U.S. Census Bureau's 2014 County Business Patterns (CBP).<sup>4</sup> Due to concerns with releasing confidential business information, the *CBP* does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 2362 (non-residential construction).

To gap-fill withheld state-level employment data:

1. State-level data for states with known employment are summed to the national level.
2. State-level known employment is subtracted from the national total reported in the national-level CBP.
3. Each of the withheld states is assigned the midpoint of the range code. Table 1 lists the range codes and midpoints.
4. The midpoints for the states with withheld data are summed to the national-level.
5. An adjustment factor is created by dividing the number of withheld employees (calculated in step 2 of this section) by the sum of the midpoints (step 4).
6. For the states with withheld employment data, the midpoint of the range for that state (step 3) is multiplied by the adjustment factor (step 5) to calculate the adjusted state-level employment for non-residential construction.

These same steps are then followed to fill in withheld data in the county-level business patterns.

1. County-level data for counties with known employment are summed by state.
2. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
3. Each of the withheld counties is assigned the midpoint of the range code (Table 1).
4. The midpoints for the counties with withheld data are summed to the state level.
5. An adjustment factor is created by dividing the number of withheld employees (step 2) by the sum of the midpoints (step 4).
6. For counties with withheld employment data, the midpoints (step 3) are multiplied by the adjustment factor (step 5) to calculate the adjusted county-level employment for non-residential construction.

Note that step 5 adjusts all counties within each state with withheld employment data by the same state-based proportion. It is unlikely that actual employment corresponds exactly with this smoothed adjustment method, but this method is the best option given the availability of the data.

**Table 1. Ranges and Midpoints for Data Withheld from State and County Business Patterns**

Range Letter	Ranges	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2014 CBP data for NAICS 2362 (non-residential construction) in Arizona provided in Table 2.

**Table 2. 2014 CBP for NAICS 2361 in Arizona**

fipsstate	fipscty	naics	empflag	emp
04	001	2362	A	withheld
04	003	2362	B	withheld
04	005	2362		177
04	007	2362		11
04	009	2362	A	withheld
04	011	2362	H	withheld
04	012	2362	A	withheld
04	013	2362		7,945
04	015	2362		47
04	017	2362		79
04	019	2362		2,220
04	021	2362		112
04	023	2362	A	withheld
04	025	2362		171
04	027	2362		359

1. The total of employees not including withheld counties is 11,121.
2. The state-level *CBP* reports 13,952 employees for NAICS 2362. The difference is 2,831.
3. County 001 is given a midpoint of 10 (since range code A is 0-19) and County 011 is given a midpoint of 3,750.
4. State total for these all withheld counties is 3,850.
5.  $2,831/3,850 = 0.74$ .
6. The adjusted employment for county 001 is  $10 \times 0.74 = 7.35$ . County 011 has an adjusted employment of  $3,750 \times 0.74 = 2,757.47$ .

The county-level employment data are used to allocate the national-level non-residential construction spending data to the county-level (see equations 1 and 2).

## E. Emissions Factors

Due to regional variances in soil moisture and silt content, emissions factors for PM10 and PM25 are calculated for each county. The initial PM10 emissions factor from non-residential construction is 0.19 tons/acre-month.<sup>5</sup> The duration of construction activity for non-residential construction is assumed to be 11 months.

To account for the soil moisture level, the PM10 emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each state are estimated based on PE values for specific climatic divisions within a state.<sup>5</sup> The average PE value for the test sites from which the PM10 emissions factor was developed is 24. Equation 5 adjusts the county-level emissions factor based on this PE value.

To account for the silt content, the PM10 emissions are weighted using average silt content for each county. EPA uses the National Cooperative Soil Survey Microsoft Access Soil Characterization Database to develop county-level, average silt content values for surface soil.<sup>6</sup> The U.S. Department of Agriculture and the National Cooperative Soil Survey define silt content of surface soil as the percentage of particles (mass basis) of diameter smaller than 50 micrometers (µm) found in the surface soil.\* This database contains the most commonly requested data from the National Cooperative Soil Survey Laboratories including data from the Kellogg Soil Survey Laboratory and cooperating universities. The average silt content for the test sites from which the PM10 emissions factor was developed is 9%. Equation 5 adjusts the county-level emissions factor based on this silt content value.

$$EF_{PM10,c} = ef_{PM10} \times \frac{24}{PE_s} \times \frac{S_c}{9\%} \quad (5)$$

Where:

- $EF_{PM10,c}$  = PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state *s* and county *c*, in tons/acre-month
- $ef_{PM10}$  = Initial PM<sub>10</sub> emissions factor for non-residential construction, 0.19 tons/acre-month
- $PE_s$  = Precipitation-evaporation value for state *s*
- $S_c$  = Percent dry silt content in soil for county *c*

Once PM<sub>10</sub> adjustments have been made, PM<sub>2.5</sub> emissions are set to 10% of PM<sub>10</sub>.<sup>7</sup>

$$EF_{PM25,c} = 0.10 \times EF_{PM10,c} \quad (6)$$

Where:

- $EF_{PM10,c}$  = PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state *s* and county *c*, in tons/acre-month
- $EF_{PM25,c}$  = PM<sub>2.5</sub> emission factor corrected for soil moisture and silt content in county *c*, in tons/acre-month

Primary PM emissions are equal to filterable emissions as there are no condensable emissions from dust from non-residential construction.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The total annual PM emissions from non-residential construction in each county are calculated by multiplying the acres disturbed by the emissions factors calculated in equations 5 and 6 and by the duration of construction activity.

$$E_{p,c} = A_c \times EF_{p,c} \times M \quad (7)$$

Where:

- $E_{p,c}$  = Annual emissions of pollutant *p* in county *c*
- $A_c$  = Acres disturbed from non-residential construction in county *c*

\* Note that this definition is different than the U.S. Environmental Protection Agency's definition that includes all particles (mass basis) of diameter smaller than 75 micrometers.

$EF_{PM10,c}$  = PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state  $s$  and county  $c$ , in tons/acre-month  
 $EF_{PM2.5,c}$  = PM<sub>2.5</sub> emission factor corrected for soil moisture and silt content in county  $c$ , in tons/acre-month  
 $M$  = Duration of construction activity in months, assumed to be 11 months

## H. Point Source Subtraction

There are no point source-specific SCCs for non-residential construction dust; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 lists sample calculations to determine the dust emissions from non-residential construction in Grand Traverse County, Michigan.

**Table 3. Sample calculations for Non-Residential construction in Grand Traverse County, Michigan**

Eq. #	Equation	Values for Grand Traverse County, MI	Result
1	$EmpFr_c = \frac{Emp_c}{Emp_{US}}$	$\frac{120 \text{ nonres construction employees}}{582,574 \text{ nonres construction employees}}$	0.000206 fraction of non-residential construction employees in Grand Traverse County, MI
2	$CS_c = EmpFrac_c \times CS_{US}$	$0.000206 \text{ fraction of employees in Grand Traverse} \times \$347,666 \text{ million in nonres construction spending in the US}$	\$71.61 million in non-residential construction spending in Grand Traverse County, MI
3	$Apd_y = \frac{2 \text{ acres}}{\$1 \text{ million}} \times \frac{PD_{1992}}{PD_y}$	$\frac{2 \text{ acres disturbed}}{\$1 \text{ million}} \times \frac{57 \text{ in 1992}}{113 \text{ in 2014}}$	1.009 acres disturbed per million dollars spent on non-residential construction spending
4	$A_c = CS_c \times Apd_y$	$\$71.61 \text{ million} \times 1.009 \frac{\text{acres disturbed}}{\text{million \$}}$	72.25 acres disturbed from non-residential construction in Grand Traverse County, MI
5	$EF_{PM10,c} = ef_{PM10} \times \frac{24}{PE_s} \times \frac{S_c}{9\%}$	$0.19 \text{ tons per acre month} \times \frac{24}{103.6} \times \frac{21.95\%}{9\%}$	0.1073 tons PM10 per acre-month of non-residential construction in Grand Traverse County, MI

Eq. #	Equation	Values for Grand Traverse County, MI	Result
6	$EF_{PM_{25,c}} = 0.10 \times EF_{PM_{10,c}}$	$0.10 \times 0.1073 \text{ tons per acre month}$	0.0107 tons PM25 per acre month on non-residential construction in Grand Traverse County, MI
7	$E_{p,c} = A_c \times EF_{p,c} \times M$	$72.25 \text{ acres} \times 0.1073 \frac{\text{tons}}{\text{acre} - \text{month}} \times 11 \text{ months}$	85.3 tons PM10 emissions from non-residential construction in Grand Traverse County, MI
		$72.25 \text{ acres} \times 0.0107 \frac{\text{tons}}{\text{acre} - \text{month}} \times 11 \text{ months}$	8.5 tons PM25 emissions from non-residential construction in Grand Traverse County, MI

## J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island counties, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which serve as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> U.S. Census Bureau. 2014. *Value of Construction Put in Place*, from <http://www.census.gov/construction/c30/c30index.html>.
- <sup>2</sup> Midwest Research Institute. 1999. *Estimating Particulate Matter Emissions from Construction Operations, Final Report*, prepared for the Emission Factor and Inventory Group, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Table 5-2.
- <sup>3</sup> U.S. Census Bureau. *Price Deflator (Fisher) Index of New Single-Family Houses Under Construction*, from [https://www.census.gov/construction/nrs/pdf/price\\_uc.pdf](https://www.census.gov/construction/nrs/pdf/price_uc.pdf).
- <sup>4</sup> U.S. Census Bureau, County Business Patterns. 2014. *Complete County File [14.4mb zip]*, from [https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP\\_2014\\_00A1&prodType=table](https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2014_00A1&prodType=table).
- <sup>5</sup> Midwest Research Institute. 1996. *Improvement of Specific Emission Factors (BACM Project No. 1)*. Prepared for South Coast Air Quality Management District.
- <sup>6</sup> U.S. Department of Agriculture. *National Cooperative Soil Survey, NCSS Microsoft Access Soil Characterization Database*, from <http://ncsslabsdatamart.sc.egov.usda.gov/>.

<sup>7</sup> Midwest Research Institute. 2006. Background Document for Revisions to Find Fraction Ratios Used for AP-42 Fugitive Dust Emissions Factors. Prepared for Western Governors' Association. From <https://www3.epa.gov/ttnchie1/ap42/ch13/bgdocs/b13s02.pdf>

## CONSTRUCTION DUST - RESIDENTIAL CONSTRUCTION

### A. Source Category Description

Emissions from residential construction activity are a function of the acreage disturbed and volume of soil excavated for residential construction. PM emissions are released through a number of residential construction related activities including movement of equipment on unpaved surfaces, excavation and earthmoving activities, material transfer operations, material alterations including drilling, cutting, blasting, and surface cleaning, tracking of dirt to nearby paved surfaces that are re-suspended by traffic, land clearing, and wind erosion of soil exposed from construction.<sup>8</sup> Residential construction activity is developed from data obtained from the U.S. Department of Commerce (DOC)'s Bureau of the Census. In 2014, the emissions were 57,961 tons for PM10-PRI and PM10-FIL and 5,796 tons for PM25-PRI and PM25-FIL.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2311010000	Industrial Processes	Construction: SIC 15 - 17	Residential	Total

### B. Overview of Calculations

The calculations for estimating emissions from residential construction involve three main steps: 1) determining the number of housing starts in each county; 2) determining the amount of soil disturbed for 1-unit homes with basements; and 3) determining the amount of surface soil disturbed for all building types. The amount of soil disturbed in each county is multiplied by emissions factors to determine the emission of PM10 and PM25 in each county. Data on housing starts in each region is from the U.S. Census Bureau, and it is distributed to the counties based on county-level data on building permits. Sources of data and calculations for the activity data are discussed in more detail in section C. The process of allocating building permit data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from residential construction is discussed in section G.

### C. Activity Data

There are two activity calculations performed for this SCC, acres of surface soil disturbed and volume of soil removed for basements.

#### *Determine the Number of Housing Starts in Each County*

The US Census Bureau has 2014 data for *New Privately Owned Housing Units Started by Purpose and Design*<sup>1</sup> which provides data on housing starts based on the groupings of 1 unit, 2-4 units, and 5 or more units. Regional-level results are also provided for quarterly totals and 1 unit structures (Table 1). In order to breakdown the 2 to 4 unit category, data from a consultation with the Census Bureau in 2002 are used; approximately 1/3 of the housing starts are for 2 unit structures, and 2/3 are for 3 and 4 unit structures.

The 2014 US Census Bureau *New Privately Owned Housing Units Started by Purpose and Design*<sup>1</sup> data for 2-4 units are distributed to two categories, 2 and 3-4 units, based on a ratio for 2 and 3-4 units calculated from the 2000 US Census Bureau *National Housing Starts* data,<sup>2</sup> for each quarter in 2014. Note that 2000 is the last full year when Census housing starts data are available separately for 2-unit and 3-4 unit homes. Table 2 shows a breakdown of the 2 unit and 3-4 unit structures based on the following calculation.

$$S_{Q,n} = \left( \frac{U_n}{U_t} \right) \times S_{Q,2-4} \quad (1)$$

Where:

$S_{Q,n}$  = Housing starts, by quarter,  $Q$ , and number of units,  $n$  (2 units or 3-4 units), in thousand units  
 $U_n$  = Number of housing starts by number of units,  $n$ , from the 2000 *National Housing Starts* data, in

- thousand housing starts
- $U_t$  = Total number of housing starts for both 2 units and 3-4 units from the 2000 *National Housing Starts* data, in thousand housing starts
- $S_{Q,2-4}$  = Number of 2-4 units by quarter,  $Q$ , from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand units

**Table 1. Housing Start Data for 2014**

Quarter	Total	Structure			Region				Regional Starts of Structures with 1 unit			
		1 unit	2 to 4 units	5 units or more	NE	MW	S	W	NE	MW	S	W
Q1-14	206.0	134.0	2.0	70.0	23.0	21.0	113.0	49.0	9.0	14.0	79.0	32.0
Q2-14	275.0	183.0	3.0	89.0	28.0	53.0	130.0	62.0	15.0	34.0	91.0	42.0
Q3-14	282.0	178.0	4.0	100.0	32.0	49.0	134.0	65.0	14.0	32.0	92.0	39.0
Q4-14	241.0	154.0	4.0	84.0	26.0	39.0	118.0	58.0	13.0	25.0	83.0	32.0

Source: Reference 1

**Table 2. Breakdown of 2 to 4 unit structures**

Quarter	Structure		
	2 to 4 units	2 units	3-4 units
Q1-14	2.0	0.74	1.26
Q2-14	3.0	1.11	1.89
Q3-14	4.0	1.47	2.53
Q4-14	4.0	1.47	2.53

Ratios of the number of 2, 3-4, and 5 or more unit structures are then used to estimate the number of structures of each type in each region. The ratios are calculated by dividing the housing starts by quarter for each unit type by the total housing starts for buildings with 2 or more units.

$$r_{Q,n} = \frac{S_{Q,n}}{S_{Q,t}} \quad (2)$$

Where:

- $r_{Q,n}$  = Ratio of structures with number of units,  $n$ , to total number of units by quarter,  $Q$
- $S_{Q,n}$  = Housing starts, by quarter,  $Q$ , and number of units,  $n$ , from distributed calculation in Step 1 for the 2-unit or 3-4 unit categories or directly from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data for the 5 units or more category, in thousand housing starts
- $S_{Q,t}$  = Housing starts, by quarter,  $Q$ , for total number of buildings with 2 or more units,  $t$  (excludes 1-unit category), in thousand housing starts

The ratio is then used to distribute the 2014 *New Privately Owned Housing Units Started by Purpose and Design* regional data for all unit types to the 2, 3-4, or 5 or more unit categories within each Census region – Northeast, Midwest, South, and West.

$$A_{Q,n,rgn} = r_{Q,n} \times (RS_{t,rgn} - RS_{1,rgn}) \quad (3)$$

Where:

- $A_{Q,n,rgn}$  = Number of housing units started in quarter  $Q$ , by number of units,  $n$ , and region of the country,

- rgn*, in thousand units
- $r_{Q,n}$  = Ratio of structures with number of units,  $n$ , to total number of units by quarter,  $Q$
- $RS_{t,rgn}$  = Total regional starts from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts
- $RS_{1,rgn}$  = Regional starts of structures with 1 unit from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts

Data from the Census report *New Privately Owned Housing Units Authorized Unadjusted Units*<sup>3</sup> is used to calculate a conversion factor to determine the ratio of structures to units in the 5 or more unit category. The conversion factor is calculated by dividing the total number of units in structures with 5 or more units by region<sup>2</sup> by the total number of buildings with 5 or more units by region.<sup>3</sup>

$$CF_{5,rgn} = \frac{U_{5,rgn}}{B_{5,rgn}} \quad (4)$$

Where:

- $CF_{5,rgn}$  = Ratio of 5 units or more to the number of buildings with 5 units or more by region,  $rgn$
- $U_{5,rgn}$  = Total number of 5 or more units by region,  $rgn$
- $B_{5,rgn}$  = Total number of buildings with 5 or more units by region,  $rgn$

Structures started by category are then calculated at a regional level by summing the number of housing unit starts across all four quarters and dividing by the number of units in each building type. For the 3-4 unit type, the number of units per building is 3.5. The value is multiplied by 1,000 because the Census data are in units of thousand building starts.

For buildings with 1, 2, or 3-4 units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{n} \quad (5)$$

Where:

- $B_{n,rgn}$  = Number of building starts by the unit number category,  $n$ , and by region,  $rgn$
- $A_{Q,n,rgn}$  = Number of housing units started in quarter  $Q$ , by number of units,  $n$ , and region of the country,  $rgn$ , in thousand units
- $n$  = Number of units per building

For buildings with 5 or more units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{CF_5} \quad (6)$$

Where:

- $B_{n,rgn}$  = Number of building starts by the unit number category,  $n$ , and by region,  $rgn$
- $A_{Q,n,rgn}$  = Number of housing units started in quarter  $Q$ , by number of units,  $n$ , and region of the country,  $rgn$ , in thousand units
- $CF_5$  = Ratio of 5 units or more to the number of buildings with 5 units or more

Annual county-level building permit data were purchased from the US Census Bureau for 2014.<sup>4</sup> The 2014 County Level Residential Building Permit dataset has 2014 data to allocate regional housing starts to the county level. This results in county-level housing starts by number of units.

The number of building permits for each unit number category by region is calculated by summing the county-level Census data to the Census region level.

$$BP_{n,rgn} = \sum BP_{n,c} \quad (7)$$

Where:

$$\begin{aligned} BP_{n,rgn} &= \text{Number of building permits by the unit number category, } n, \text{ and by region, } rgn \\ BP_{n,c} &= \text{Number of building permits by the unit number category, } n, \text{ and by county, } c \end{aligned}$$

The ratio of the number of building permits by county to the total number of building permits by region in which the county is located, for each unit number category, is then calculated.

$$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}} \quad (8)$$

Where:

$$\begin{aligned} R_{BP,c} &= \text{Ratio of building permits, } BP, \text{ to total regional building permits in county } c \\ BP_{n,c} &= \text{Number of building permits by the unit number category, } n, \text{ and by county, } c \\ BP_{n,rgn} &= \text{Number of building permits by the unit number category, } n, \text{ and by region, } rgn \end{aligned}$$

The final number of building starts for each unit type category is then calculated at the county-level by multiplying the number of structures started at the regional level and the building permit ratio.

$$B_{n,c} = B_{n,rgn} \times R_{BP,c} \quad (9)$$

Where:

$$\begin{aligned} B_{n,c} &= \text{Number of building starts by the unit number category, } n, \text{ and by county, } c \\ B_{n,rgn} &= \text{Number of building starts by the unit number category, } n, \text{ and by region, } rgn \\ R_{BP,c} &= \text{Ratio of building permits, } BP, \text{ to total regional building permits in county } c \end{aligned}$$

#### ***Determine Amount of Soil Removed for Basements***

To calculate basement soil removal, the 2014 *Characteristics of New Single-Family Houses Completed, Foundation table*<sup>5</sup> is used to estimate the percentage of 1-unit structures that have a basement at the regional level. The data indicate whether the structure has a full/partial basement, slab or other type, or crawl space. However, only structures with full/partial basements are used in this calculation.

$$BM_{rgn} = \frac{BM_{fp,rgn}}{BM_{t,rgn}} \quad (10)$$

Where:

$$\begin{aligned} BM_{rgn} &= \text{Fraction of basements for buildings in the region} \\ BM_{fp,rgn} &= \text{Number of full or partial basements, } fp, \text{ by region, } rgn \\ BM_{t,rgn} &= \text{Total number of houses regardless of basement type (full/partial, slab/other, crawl space by region, } rgn \end{aligned}$$

To estimate the number of building starts with and without basements in each county, the county level estimate of the number of 1-unit starts (from equation 9) is multiplied by the percent of 1-unit houses in the region that have a basement.

$$B_{c,BM} = B_{n,c} \times BM_{rgn} \quad (11)$$

$$B_{c,nBM} = B_{n,c} \times (1 - BM_{rgn}) \quad (11a)$$

Where:

$$\begin{aligned} B_{c,BM} &= \text{Number of building starts by county, } c, \text{ with a basement, } BM \\ B_{c,nBM} &= \text{Number of building starts by county, } c, \text{ without a basement, } BM \end{aligned}$$

- $B_{n,c}$  = Number of building starts by the unit number category,  $n$ , and by county,  $c$   
 $BM_{rgn}$  = Fraction of basements for buildings in the region

Basement volume is calculated by assuming a house with a 2000 square foot footprint has a basement dug to a depth of 8 feet (making 16,000 ft<sup>3</sup> per basement). An additional 10% is added for peripheral dirt bringing the total to 17,600 ft<sup>3</sup> (651.85 yd<sup>3</sup>) per basement.

### ***Determine Amount of Soil Disturbed by Unit Type***

The number of acres of soil disturbed by the construction of residential buildings is calculated for apartment buildings, buildings with 2 units, and buildings with 1 unit. Table 3 below shows the assumptions used for the surface area disturbed for each unit type. Buildings with unit types of 3-4 and 5 or more are grouped together as apartments in this step.

**Table 3. Surface Soil removed per unit type**

Structure Type	Acres disturbed
1-Unit	1/4 acre per structure
2-Unit	1/3 acre per structure
Apartment	1/2 acre per structure

For apartment buildings (sum of 3-4 and 5 or more units) and buildings with 2 units:

$$S_{n,c} = B_{n,c} \times a_n \quad (12)$$

Where:

- $S_{n,c}$  = Surface soil disturbed by building construction by county,  $c$ , and unit type category,  $n$ , in acres  
 $B_{n,c}$  = Number of building starts by the unit type category,  $n$ , and by county,  $c$   
 $a_n$  = Acres of surface soil disturbed by each unit type category,  $n$ . See Table 3 for values for each type.

For buildings with 1 unit, with or without a basement:

$$S_{n,c} = B_{c,BM} \times a_n \quad (13)$$

Where:

- $S_{n,c}$  = Surface soil disturbed by building construction by county,  $c$ , and unit type category,  $n$ , in acres  
 $B_{c,BM}$  = Number of buildings by county,  $c$ , with or without a basement,  $BM$   
 $a_n$  = Acres of surface soil disturbed by each unit type category,  $n$ . See Table 3 for values for each type.

## **D. Allocation Procedure**

Annual county building permit data were purchased from the US Census Bureau for 2014.<sup>4</sup> The 2014 County Level Residential Building Permit dataset is used to allocate regional housing starts to the county level. See Section C for more information.

## **E. Emissions Factors**

Initial PM<sub>10</sub> emissions from construction of single family, 2-unit, and apartments structures are calculated using the emissions factors given in Table 4. These emissions factors describe average “unit operations,” such as “loading and unloading of earth and aggregate materials, land clearing and general vehicle traffic.”<sup>6</sup> They therefore take into account the entire duration of construction, and not simply the duration of active excavation. The duration of construction activity for houses is assumed to be 6 months and the duration of construction for apartments is assumed to be 12 months.

**Table 4. Emissions Factors for Residential Construction**

Type of Structure	Emissions Factor	Duration of Construction
Apartments	0.11 tons PM10/acre-month	12 months
2-Unit Structures	0.032 tons PM10/acre-month	6 months
1-unit Structures with Basements	0.011 tons PM10/acre-month	6 months
	0.059 tons PM10/1000 cubic yards	
1-Unit Structures w/o Basements	0.032 tons PM10/acre-month	6 months

Source: Reference **Error! Bookmark not defined.**

To account for the soil moisture level, the PM10 emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each state are estimated based on PE values for specific climatic divisions within a state. The average PE value for the test sites from which the PM10 emissions factor was developed is 24.<sup>6</sup> Equation 14 is used to adjust the county-level emissions factor based on this PE value.

To account for the silt content, the PM10-PRI emissions are weighted using average silt content for each county. EPA used the National Cooperative Soil Survey Microsoft Access Soil Characterization Database to develop county-level, average silt content values for surface soil.<sup>7</sup> The U.S. Department of Agriculture and the National Cooperative Soil Survey define silt content of surface soil as the percentage of particles (mass basis) of diameter smaller than 50 micrometers (µm) found in the surface soil.\* This database contains the most commonly requested data from the National Cooperative Soil Survey Laboratories including data from the Kellogg Soil Survey Laboratory and cooperating universities. The average silt content for the test sites from which the PM10 emissions factor was developed is 9%.<sup>6</sup> Equation 7 is used to adjust the county-level emissions factor based on this silt content value.

$$AF_{PM10} = \frac{24}{PE} \times \frac{s}{9\%} \quad (14)$$

Where:

$AF_{PM10}$  = PM10-PRI adjustment factor  
 $PE$  = precipitation-evaporation value for each State  
 $s$  = % dry silt content, by county, in soil for area being inventoried

This adjustment factor is used to adjust the PM10-PRI emissions factor for each unit type category – apartment, 2-unit, 1-unit with basement, and 1-unit without basement.

$$EF_{p,n,c} = AF_{PM10} \times D_n \times EF_{orig} \quad (15)$$

Where:

$EF_{p,n,c}$  = Adjusted county-level,  $c$ , PM10-PRI emissions factor,  $p$ , for each unit type category,  $n$ , in tons/acre  
 $AF_{PM10}$  = PM10-PRI adjustment factor  
 $D_n$  = Duration of construction by unit type category,  $n$ , in months. See Table 4 for duration values.

\* Note that this definition is different than the U.S. Environmental Protection Agency's definition that includes all particles (mass basis) of diameter smaller than 75 micrometers.

$EF_{orig}$  = Original unadjusted PM10 emissions factor, in tons/acre. See Table 4 for original emissions factors.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The PM10-PRI emissions are calculated by taking the sum of the surface soil disturbed by county and unit type category and multiplying it by the corresponding adjusted PM10-PRI emissions factor. Once PM10-PRI adjustments have been made, PM25-PRI emissions are estimated by applying a particle size multiplier of 0.10 to PM10-PRI emissions.<sup>8</sup> Primary PM emissions are equal to filterable emissions since there are no condensible emissions from residential construction.

The PM10-PRI emissions are calculated at the county-level by multiplying the surface soil disturbed from construction for each unit type by the corresponding emissions factor for that unit type, and then summed across unit types.

$$E_{PM10,c} = \sum_{n=1}^N S_{n,c} \times EF_{PM10,n,c} \quad (16)$$

Where:

$E_{PM10,c}$  = Total PM10-PRI emissions in county  $c$ , in tons  
 $S_{n,c}$  = Surface soil disturbed by building construction by county,  $c$ , and unit type category,  $n$   
 $EF_{p,n,c}$  = Adjusted county-level,  $c$ , PM<sub>10</sub> emissions factor,  $p$ , for each unit type category,  $n$ , in tons/acre

The PM25-PRI emissions are calculated based on the assumption that they are 10% of the PM10-PRI emissions.

$$E_{PM2.5,c} = E_{PM10,c} \times 0.1 \quad (17)$$

Where:

$E_{PM2.5,c}$  = Total county-level,  $c$ , PM25-PRI emissions  
 $E_{PM10,c}$  = Total county-level,  $c$ , PM10-PRI emissions  
0.1 = Particle size multiplier

## H. Point Source Subtraction

There are no point source-specific SCCs for residential construction; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 5 shows sample calculations for PM10-PRI and PM25-PRI emissions from residential construction for a 2-unit structure in Suffolk County, Massachusetts. The first 3 equations use the first quarter (Q1) of 2014 for 2-unit structures as an example. However these calculations would need to be repeated to calculate values for all 4 quarters for all 3 unit sizes. Note that structures with 5 or more units and structures with 1 unit with or without a basement have additional steps not shown in the sample calculations here.

**Table 5. Sample calculations for PM-10 PRI and PM25-PRI emissions from residential construction of 2-unit structures in Suffolk County, MA.**

Eq. #	Equation	Values for Suffolk County, MA	Result
1	$S_{Q,n} = \left(\frac{U_n}{U_t}\right) \times S_{Q,2-4}$	$\left(\frac{14 \text{ two unit housing starts in 2002}}{38 \text{ total housing starts in 2002}}\right) \times 2 \text{ two to four unit housing starts in Q1 2014}$	0.74 thousand housing starts for 2-unit structures in Q1 2014, nationally
2	$r_{Q,n} = \frac{S_{Q,n}}{S_{Q,t}}$	$\frac{0.74 \text{ two unit housing starts}}{72 \text{ two or more unit housing starts}}$	0.01 ratio of buildings with 2 units to all 2 or more unit housing starts for Q1 2014, nationally
3	$A_{Q,n,rgn} = r_{Q,n} \times (RS_t - RS_1)$	$0.01 \times (23 \text{ total Q1 housing starts in Northeast} - 9 \text{ one unit housing starts in Northeast})$	0.14 thousand housing starts for 2-unit structures for Q1 2014 in the Northeast
4	$CF_5 = \frac{U_{5,rgn}}{B_{5,r}}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings
5	$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{n}$	$\frac{0.772 \text{ two unit structures} \times 1,000}{2 \text{ units per building}}$	386 2-unit structures constructed in the Northeast
6	$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{CF_5}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings
7	$BP_{n,rgn} = \sum BP_{n,c}$	$\sum \text{Northeast two unit building permits}$	1,545 2-unit structure building permits in the Northeast
8	$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}}$	$\frac{49 \text{ Suffolk county building permits}}{1,545 \text{ Northeast building permits}}$	0.03172 ratio of county-level building permits to regional-level building permits in Suffolk County, MA
9	$B_{n,c} = B_{n,rgn} \times R_{BP,c}$	$386 \times 0.03172$	12.25 total 2-unit structure building starts for Suffolk County, MA
10	$BM_{rgn} = \frac{BM_{fp,rgn}}{BM_{t,rgn}}$	N/A	Equation is for 1-unit buildings; example is for 2-unit buildings
11	$B_{c,BM} = B_{n,c} \times BM_{rgn}$	N/A	Equation is for 1-unit buildings; example is for 2-unit buildings

Eq. #	Equation	Values for Suffolk County, MA	Result
12	$S_{n,c} = B_{n,c} \times a_n$	12.25 two unit structures × 0.33 acres per structure	4.08 acres surface soil disturbed by 2-unit structures in Suffolk County, MA
13	$S_{n,c} = B_{c,BM} \times a_n$	N/A	Equation is for 1-unit buildings; example is for 2-unit buildings
14	$AF_{PM10} = \frac{24}{PE} \times \frac{s}{9\%}$	$\frac{24}{119.7 \text{ PE value for Massachusetts}} \times \frac{27.07\% \text{ silt content}}{9\%}$	0.603 PM10-PRI adjustment factor for 2-unit structures in Suffolk County, MA
15	$EF_{p,n,c} = AF_{PM10} \times D_{m,n} \times EF_{orig}$	$0.603 \times 6 \text{ months} \times 0.032 \text{ tons per acre}$	0.1158 tons/acre PM10-PRI emissions factor for 2-unit structures in Suffolk County, MA
16	$E_{PM10,c} = \sum S_{n,c} \times EF_{p,n,c}$	$4.08 \text{ acres} \times 0.1158 \text{ tons per acre}$	0.47 tons PM10-PRI emissions for 2-unit structures in Suffolk County, MA
17	$E_{PM2.5,c} = E_{PM10,c} \times 0.1$	$0.47 \text{ tons} \times 0.1$	0.047 tons PM25-PRI emissions for 2-unit structures in Suffolk County, MA

## J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> U.S. Census Bureau, New Privately Owned Housing Units Started by Purpose and Design in 2014 [http://www.census.gov/construction/nrc/pdf/quarterly\\_starts\\_completions.pdf](http://www.census.gov/construction/nrc/pdf/quarterly_starts_completions.pdf).
- <sup>2</sup> U.S. Census Bureau. 2001. Housing Starts. Table 1. <https://www.census.gov/prod/2001pubs/c20-0103.pdf>.
- <sup>3</sup> U.S. Census Bureau, New Privately Owned Housing Units Authorized - Unadjusted Units for Regions, Divisions, and States, Annual 2010, Table 2au. <https://www.census.gov/construction/bps/txt/tb2u2014.txt>.
- <sup>4</sup> U.S. Census Bureau, Annual Housing Units Authorized by Building Permits CO2014A, purchased September 2015.
- <sup>5</sup> U.S. Census Bureau, Characteristics of New Single Family Houses Completed, Annual 2014, Foundation Table.

<https://www.census.gov/construction/chars/pdf/c25ann2014.pdf>

- <sup>6</sup> Midwest Research Institute. 1996. Improvement of Specific Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District.
- <sup>7</sup> U.S. Department of Agriculture, National Cooperative Soil Survey, NCSS Microsoft Access Soil Characterization Database, from <http://ncsslabsdatamart.sc.egov.usda.gov/>.
- <sup>8</sup> Cowherd, C. J. Donaldson, R. Hegarty, and D. Ono. 2006. Proposed Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors. 15<sup>th</sup> International Emission Inventory Conference, New Orleans, LA. <http://www.epa.gov/ttn/chief/conference/ei15/session14/cowherd.pdf>.
- <sup>8</sup> Midwest Research Institute. 1999. Estimating Particulate Matter Emissions from Construction Operations. Prepared for Emission Factor and Inventory Group, Office of Air Quality Planning and Standards US EPA.

## CONSTRUCTION DUST – ROAD CONSTRUCTION

### A. Source Category Description

Emissions from this source category include dust emissions from road construction. Estimates of emissions of particulate matter less than 10 µm in diameter (PM10) and less than 2.5 µm in diameter (PM25) from road construction are based on the acreage disturbed for construction activities. In 2014, road construction in the US, Puerto Rico and US Virgin Islands resulted in approximately 112,279 tons of PM10-PRI and 11,228 tons of PM25-PRI emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2311030000	Industrial Processes	Construction: SIC 15 - 17	Road Construction	Total

### B. Overview of Calculations

The calculations for estimating the emissions from road construction involve first estimating the acres disturbed from new road constructed in each county. The amount of state-level road construction spending by road type is available from the Federal Highway Administration (FHWA) and is converted to acreage disturbed using conversion factors from the Florida Department of Transportation (FLDOT). The state-level acreage disturbed by road type is summed together and distributed to the counties based on the proportion of building starts in each county. Emissions factors for PM10 and PM25 are calculated based on precipitation-evaporation values and dry silt content in each county. The total amount of acres disturbed is multiplied by these emissions factors to estimate emissions of PM from road construction. Sources of data and calculations for the amount of new road constructed are discussed in section C. The process of allocating road construction activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from road construction is discussed in section G.

### C. Activity Data

The activity data for this source category is the acreage disturbed from new road construction, which is estimated using data from FHWA's *Highway Statistics, State Highway Agency Capital Outlay 2014, Table SF-12A*<sup>1</sup> and FLDOT's *Generic Cost per Mile Models*.<sup>2</sup> From the FHWA table, the following construction types are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. Each of the following road types have spending broken out for each construction type:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban
4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

Construction spending for each road type is summed across all construction types to determine the total annual highway spending for each road type.

$$HS_{s,r} = \sum_{ct} S_{s,r} \quad (1)$$

Where:

$HS_{s,r}$  = Annual highway spending for road type  $r$  in state  $s$ , in dollars  
 $ct$  = Construction type

$S_{s,r}$  = Annual spending per construction type in state  $s$  for road type  $r$ , in dollars

State expenditure data are converted to miles of new road and acres disturbed per mile of new road by applying conversions based on data obtained from FLDOT. The conversions are shown in Table 1, and the acres disturbed per mile conversions are calculated by multiplying the FLDOT's total affected roadway width (including all lanes, shoulders, and areas affected beyond the road width) in feet by the number of feet in a mile and converting the resulting land area from ft<sup>2</sup> to acres. There are 5,280 feet in a mile, and 43,560 ft<sup>2</sup> in an acre.

$$RC_{m,s,r} = \frac{HS_{s,r}}{TDM} \quad (2)$$

$$RC_{a,s,r} = RC_{m,s,r} \times ADM \quad (3)$$

Where:

$RC_{m,s,r}$  = Miles of FHWA road type  $r$  constructed in state  $s$   
 $RC_{a,s,r}$  = Acres of land disturbed for construction of FHWA road type  $r$  in state  $s$   
 $HS_{s,r}$  = Annual highway spending for road type  $r$  in state  $s$   
 $TDM$  = Conversion of dollars spent to road miles constructed, in thousand dollars per mile  
 $ADM$  = Conversion of road miles constructed to acres disturbed, in acres per mile

**Table 1. Spending per Mile and Acres Disturbed per Mile by Highway Type**

Road Type	Thousand Dollars per mile	Total Affected Roadway Width (ft)*	Acres Disturbed per mile
Urban Areas, Interstate	6,895	94	11.4
Rural Areas, Interstate	3,810	89	10.8
Urban Areas, Other Arterials	4,112	63	7.6
Rural Areas, Other Arterials	2,076	55	6.6
Urban Areas, Collectors	4,112	63	7.6
Rural Areas, Collectors	2,076	55	6.6
*Total Affected Roadway Width = (lane width (12 ft) * number of lanes) + (shoulder width * number of shoulders) + area affected beyond road width (25 ft)			

Source: Reference 2.

The acres of land disturbed by road type can then be summed across all road types in a state to calculate the total state-level acreage disturbed due to new road construction.

$$A_s = \sum_r RC_{a,s} \quad (4)$$

Where:

$A_s$  = Acres of land disturbed for all road construction in state  $s$   
 $RC_{a,s}$  = Acres of land disturbed for construction of FHWA road type  $r$  in state  $s$

The process used to distribute the state-level amount of acreage disturbed to the counties is discussed in section D.

#### **D. Allocation Procedure**

Building permits data, used as a surrogate for road construction activity, from the U.S. Census Bureau are used to

allocate the state-level acres disturbed by road construction to the county-level.<sup>3</sup> Specifically, the ratio of the county- to state-level number of building starts is calculated and multiplied by the state-level acreage disturbed (from equation 4) to estimate the county-level acreage disturbed by road construction.

$$BFrac_c = \frac{Build_c}{Build_s} \quad (5)$$

$$A_c = A_s \times BFrac_c \quad (6)$$

Where:

- $BFrac_c$  = The fraction of building starts in county  $c$
- $Build_c$  = The number of building starts in county  $c$
- $Build_s$  = The number of building starts in state  $s$
- $A_c$  = Acres of land disturbed for road construction in county  $c$
- $A_s$  = Acres of land disturbed for all road construction in state  $s$

## E. Emissions Factors

Due to regional variances in soil moisture and silt content, uncontrolled emissions factors for PM<sub>10</sub> and PM<sub>2.5</sub> are adjusted for each county. The initial uncontrolled PM<sub>10</sub> emissions factor from construction of roads is 0.42 tons/acre-month.<sup>4</sup> This emission factor represents the large amount of dirt moved during the construction of roadways, reflecting the high level of cut and fill activity that occurs at road construction sites.

To account for the soil moisture level, the uncontrolled PM<sub>10</sub> emissions are weighted using the 30-year average precipitation-evaporation (PE) values from Thornthwaite's PE Index. Average precipitation evaporation values for each state are estimated based on PE values for specific climatic divisions within a state.<sup>4</sup> The average PE value for the test sites from which the PM<sub>10</sub> emissions factor was developed is 24. Equation 7 adjusts the county-level uncontrolled emissions factor based on this PE value.

To account for the silt content, the uncontrolled PM<sub>10</sub> emissions are weighted using average silt content for each county. EPA uses the National Cooperative Soil Survey Microsoft Access Soil Characterization Database to develop county-level, average silt content values for surface soil.<sup>5</sup> The U.S. Department of Agriculture and the National Cooperative Soil Survey define silt content of surface soil as the percentage of particles (mass basis) of diameter smaller than 50 micrometers (μm) found in the surface soil.\* This database contains the most commonly requested data from the National Cooperative Soil Survey Laboratories including data from the Kellogg Soil Survey Laboratory and cooperating universities. The average silt content for the test sites from which the PM<sub>10</sub> emissions factor was developed is 9%. Equation 7 adjusts the county-level uncontrolled emissions factor based on this silt content value.

$$UEF_{PM10,c} = EF_{PM10} \times \frac{24}{PE_s} \times \frac{S_c}{9\%} \quad (7)$$

Where:

- $UEF_{PM10,c}$  = Uncontrolled PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state  $s$  and county  $c$ , in tons/acre-month
- $EF_{PM10}$  = Initial PM<sub>10</sub> emissions for road construction, 0.42 tons/acre-month
- $PE_s$  = Precipitation-evaporation value for state  $s$
- $S_c$  = Percent dry silt content in soil for county  $c$

Once uncontrolled PM<sub>10</sub> adjustments have been made, uncontrolled PM<sub>2.5</sub> emissions are set to 10% of PM<sub>10</sub>.

\* Note that this definition is different than the U.S. Environmental Protection Agency's definition that includes all particles (mass basis) of diameter smaller than 75 micrometers.

$$UEF_{PM25,c} = 0.10 \times UEF_{PM10,c} \quad (8)$$

Where:

- $UEF_{PM10,c}$  = Uncontrolled PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state  $s$  and county  $c$ , in tons/acre-month  
 $UEF_{PM25,c}$  = Uncontrolled PM<sub>2.5</sub> emission factor corrected for soil moisture and silt content in county  $c$ , in tons/acre-month

Primary PM emissions are equal to filterable emissions as there are no condensable dust emissions from road construction.

## F. Controls

Dust emissions from road construction are generally controlled by watering the construction site. The Midwest Research Institute recommends using a control efficiency of 50% for PM<sub>10</sub> and PM<sub>25</sub> emissions from road construction.<sup>6</sup>

$$EF_{p,c} = 0.50 \times UEF_{p,c} \quad (9)$$

Where:

- $EF_{p,c}$  = Controlled emissions factor of pollutant  $p$  in county  $c$   
 $UEF_{p,c}$  = Uncontrolled emissions factor of pollutant  $p$  in county  $c$

## G. Emissions

The total annual dust emissions from road construction in each county are multiplied by the emissions factors calculated in equation 9. The duration of construction activity for road construction is assumed to be 12 months.

$$E_{p,c} = A_c \times EF_{p,c} \times M \quad (10)$$

Where:

- $E_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$   
 $A_c$  = Acres of land disturbed for road construction in county  $c$   
 $EF_{PM10,c}$  = Controlled PM<sub>10</sub> emission factor corrected for soil moisture and silt content in state  $s$  and county  $c$ , in tons/acre-month  
 $EF_{PM25,c}$  = Controlled PM<sub>2.5</sub> emission factor corrected for soil moisture and silt content in county  $c$ , in tons/acre-month  
 $M$  = Duration of construction activity in months

## H. Point Source Subtraction

There are no point source-specific SCCs for road construction; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 2 lists sample calculations to determine the dust emissions from road construction in Newport County, Rhode Island.

**Table 2. Sample calculations for Urban Interstate, Urban Other Arterial, and Urban Collector Road Construction in Newport County, RI**

Eq. #	Equation	Values for Newport County, RI	Result
1	$HS_{s,r} = \sum_{ct} S_{s,r}$	\$1,000 + \$9,155,000	\$9,156,000 spent on urban interstate construction in RI
		\$1,276,000 + \$2,471,000	\$3,747,000 spent on urban other arterial construction in RI
		\$2,583,000	\$2,583,000 spent on urban collector construction in RI
2	$RC_{m,s,r} = \frac{HS_{s,r}}{TDM}$	$\frac{\$9,156,000}{6,895,000 \text{ \$ per mile}}$	1.328 miles of urban interstate constructed in RI
		$\frac{\$3,747,000}{4,112,000 \text{ \$ per mile}}$	0.911 miles of urban other arterial constructed in RI
		$\frac{\$2,683,000}{4,112,000 \text{ \$ per mile}}$	0.628 miles of urban collector constructed in RI
3	$RC_{a,s,r} = RC_{m,s,r} \times ADM$	1.328 miles $\times$ 11.4 acres per mile =	15.1 acres disturbed from urban interstate construction in RI
		0.911 miles $\times$ 7.6 acres per mile	6.9 acres disturbed from urban other arterial construction in RI
		0.628 miles $\times$ 7.6 acres per mile	4.8 acres disturbed from urban collector construction in RI
4	$A_s = \sum_r RC_{a,s}$	15.1 acres + 6.9 acres + 4.8 acres	26.78 acres disturbed from urban road construction in RI
5	$Bfrac_c = \frac{Build_c}{Build_s}$	$\frac{185 \text{ building starts in Newport County}}{952 \text{ building starts in RI}}$	0.194 fraction of building starts in Newport County, RI
6	$A_c = A_s \times Bfrac_c$	26.78 acres $\times$ 0.194	5.20 acres disturbed from urban road construction in Newport County, RI
7	$UEF_{PM10,c} = EF_{PM10} \times \frac{24}{PE_s} \times \frac{S_c}{9\%}$	$0.42 \text{ tons/acre-month} \times \frac{24}{132} \times \frac{41,45\%}{9\%}$	0.3517 tons per acre-month uncontrolled PM10 emissions from road construction in Newport County, RI

Eq. #	Equation	Values for Newport County, RI	Result
8	$UEF_{PM25,c} = 0.10 \times UEF_{PM10,c}$	$0.10 \times 0.3517 \text{ tons/acre} - \text{month}$	0.0352 tons per acre-month PM25 emissions from road construction in Newport County, RI
9	$EF_{p,c} = 0.50 \times UEF_{p,c}$	$0.50 \times 0.3514 \text{ tons per acre} - \text{month}$	0.1758 tons per care-month controlled PM10 emissions from new road construction in Newport County, RI
		$0.50 \times 0.0352 \text{ tons per acre} - \text{month}$	0.0176 tons per care-month controlled PM25 emissions from new road construction in Newport County, RI
10	$E_{p,c} = A_c \times EF_{p,c} \times M$	$5.2 \text{ acres} \times 0.1758 \text{ tons/acre} - \text{month} \times 12$	10.98 tons PM10 from urban road construction in Newport County, RI
		$5.2 \text{ acres} \times 0.0176 \text{ tons/acre} - \text{month} \times 12$	1.98 tons PM25 from urban road construction in Newport County, RI

## J. Changes from 2014 Methodology

The only change from the methodology used to calculate the 2014 v2 NEI emissions is the addition of a 50% control due to watering of construction sites.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island county, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- 1 Federal Highway Administration. 2014 Highway Spending, from <http://www.fhwa.dot.gov/policyinformation/statistics/2014/sf12a.cfm>.
- 2 Florida Department of Transportation. Generic Cost per Mile Models for 2014. <http://www2.dot.state.fl.us/programmanagement/costpermile.aspx>.
- 3 U.S. Census Bureau. 2015. Annual Housing Units Authorized by Building Permits CO2014A.
- 4 Midwest Research Institute. 1996. Improvement of Specific Emission Factors (BACM Project No. 1). Prepared for South Coast Air Quality Management District.
- 5 U.S. Department of Agriculture, National Cooperative Soil Survey, NCSS Microsoft Access Soil Characterization Database, from <http://ncsslabsdatamart.sc.egov.usda.gov/> (accessed May 2018).

6 Midwest Research Institute. Kansas City, Missouri, 1999. Estimating Particulate Matter Emissions from Construction Operations. Prepared for Emissions Factor and Inventory Group, Office of Air Quality Planning and Standards.

## OPEN BURNING – LAND CLEARING DEBRIS

### A. Source Category Description

Open burning of land clearing debris is the purposeful burning of debris, such as trees, shrubs, and brush, from the clearing of land for the construction of new buildings and highways. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates from open burning of land clearing debris are a function of the amount of material or fuel subject to burning per year. In 2014, open burning from land clearing debris resulted in approximately 87,277 tons of PM<sub>2.5</sub>-PRI emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000500	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Land Clearing Debris (use 28-10-005-000 for Logging Debris Burning)

### B. Overview of Calculations

The emissions from open burning from land clearing debris are estimated based on the number of acres disturbed from non-residential, residential, and road construction. The number of acres disturbed is multiplied by a fuel loading factor to determine the amount of land clearing debris burned in each county. This number is multiplied by emissions factors to determine emissions of CAPs and HAPs. Sources of activity data and calculations are discussed in section C. The process of allocating non-residential construction activity data to the county level, allocating building permit data to the county level, and allocating road construction activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from open burning from land clearing debris is discussed in section G.

### C. Activity Data

The amount of material burned is estimated using the county-level total number of acres disturbed by residential, non-residential, and road construction. County-level weighted loading factors are applied to the total number of construction acres to convert acres to tons of available fuel.

#### *Acres Disturbed from Non-Residential Construction*

The activity data for this non-residential construction is the acreage disturbed from non-residential construction, which is estimated using data from the U.S. Census Bureau's *Annual Value of Construction Put in Place in the U.S.*<sup>1</sup> and a conversion factor from MRI's *Estimating Particulate Matter Emissions from Construction Operations, Final Report*.<sup>2</sup> The national-level non-residential construction spending data are allocated to the county-level based on the proportion of non-residential construction employees in each county. Employment data are taken from the U.S. Census Bureau's 2014 County Business Patterns (CBP), and gaps in employment data are filled using a process described in detail in section D.

$$EmpFr_c = \frac{Emp_c}{Emp_{US}} \quad (1)$$

$$CS_c = EmpFr_c \times CS_{US} \quad (2)$$

Where:

- $EmpFr_c$  = The fraction of non-residential construction employees in county  $c$
- $Emp_c$  = The number of non-residential construction employees in county  $c$
- $Emp_{US}$  = The number of non-residential construction employees in the US
- $CS_c$  = Non-residential construction spending in county  $c$
- $CS_{US}$  = Non-residential construction spending in the US

Non-residential construction spending is converted to acres disturbed using a conversion factor from MRI's report. For the average acres disturbed per million dollars of non-residential construction, MRI reported a conversion factor of 2 acres/\$1 million (in 1992 constant dollars). The 1992 conversion factor is adjusted to 2017 using the *Price Deflator (Fisher) Index of New Single-Family Houses under Construction*.<sup>3</sup> In 2014 the conversion factor was 1.009 acres per million dollars spent on non-residential construction activities.

$$Apd_{2017} = \frac{2 \text{ acres}}{\$1 \text{ million}} \times \frac{PD_{1992}}{PD_{2017}} \quad (3)$$

Where:

$$\begin{aligned} Apd_{2017} &= \text{Acres disturbed per million dollars in 2017} \\ PD_{1992} &= \text{Price Deflator (Fisher) Index value in 1992} \\ PD_{2017} &= \text{Price Deflator (Fisher) Index value in 2017} \end{aligned}$$

County-level non-residential construction spending (from equation 2) is then multiplied by this conversion factor to estimate county-level acreage disturbed from non-residential construction activities.

$$ANR_c = CS_c \times Apd_{2017} \quad (4)$$

Where:

$$\begin{aligned} ANR_c &= \text{Acres disturbed from non-residential construction in county } c \\ CS_c &= \text{Non-residential construction spending in county } c, \text{ in million dollars} \\ Apd_{2017} &= \text{Acres disturbed per million dollars in 2017} \end{aligned}$$

### ***Acres Disturbed from Residential Construction***

The US Census Bureau has 2014 data for *Housing Starts - New Privately Owned Housing Units Started*,<sup>4,5</sup> which provides regional level housing starts based on the groupings of 1 unit, 2-4 units, 5 or more units. Regional-level results are also provided for quarterly totals and 1 unit structures (Table 1). The 2-to-4 unit category is broken down using a ratio calculated from the 2000 US Census Bureau *National Housing Starts* data for 2 and 3-4 units,<sup>6</sup> for each quarter in 2014. Note that 2000 is the last full year when Census housing starts data were available separately for 2-unit and 3-4 unit homes. Table 2 shows a breakdown of the 2 units and 3-4 unit structures based on the following calculation.

$$S_{Q,n} = \left( \frac{U_n}{U_t} \right) \times S_{Q,2-4} \quad (5)$$

Where:

$$\begin{aligned} S_{Q,n} &= \text{Housing starts, by quarter, } Q, \text{ and number of units, } n \text{ (2 units or 3-4 units), in thousand units} \\ U_n &= \text{Number of housing starts by number of units, } n, \text{ from the 2000 } \textit{National Housing Starts} \text{ data, in thousand housing starts} \\ U_t &= \text{Total number of housing starts for both 2 units and 3-4 units from the 2000 } \textit{National Housing Starts} \text{ data, in thousand housing starts} \\ S_{Q,2-4} &= \text{Number of 2-4 units by quarter, } Q, \text{ from the 2014 } \textit{New Privately Owned Housing Units Started by Purpose and Design} \text{ data, in thousand units} \end{aligned}$$

**Table 1. Housing Start Data for 2014**

Quarter	Total	Structure			Region				Regional Starts of Structures with 1 unit			
		1 unit	2 to 4 units	5 units or more	NE	MW	S	W	NE	MW	S	W
Q1-14	206.0	134.0	2.0	70.0	23.0	21.0	113.0	49.0	9.0	14.0	79.0	32.0
Q2-14	275.0	183.0	3.0	89.0	28.0	53.0	130.0	62.0	15.0	34.0	91.0	42.0
Q3-14	282.0	178.0	4.0	100.0	32.0	49.0	134.0	65.0	14.0	32.0	92.0	39.0
Q4-14	241.0	154.0	4.0	84.0	26.0	39.0	118.0	58.0	13.0	25.0	83.0	32.0

Source: Reference 5

**Table 2. Breakdown of 2 to 4 unit structures in 2014**

Quarter	Structure		
	2 to 4 units	2 units	3-4 units
Q1-14	2.0	0.74	1.26
Q2-14	3.0	1.11	1.89
Q3-14	4.0	1.47	2.53
Q4-14	4.0	1.47	2.53

Ratios of the number of 2, 3 and 4, and 5 unit structures are then used to estimate the number of structures of each type in each region. The ratios are calculated by dividing the housing starts by quarter for each unit type by the total housing starts for buildings with more than 2 units.

$$r_{Q,n} = \frac{S_{Q,n}}{S_{Q,t}} \quad (6)$$

Where:

- $r_{Q,n}$  = Ratio of structures with number of units,  $n$ , to total number of units by quarter,  $Q$   
 $S_{Q,n}$  = Housing starts, by quarter,  $Q$ , and number of units,  $n$ , from distributed calculation in Step 1 for the 2-unit or 3-4 unit categories or directly from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data for the 5 units or more category, in thousand housing starts  
 $S_{Q,t}$  = Housing starts, by quarter,  $Q$ , for total number of units greater than 2 units,  $t$  (excludes 1-unit category), in thousand housing starts

The ratio is then used to distribute the 2014 *New Privately Owned Housing Units Started by Purpose and Design*<sup>5</sup> regional data for all unit types to the 2, 3-4, or 5 or more unit categories within each Census region – Northeast, Midwest, South, and West.

$$A_{Q,n,rgn} = r_{Q,n} \times (RS_{t,rgn} - RS_{1,rgn}) \quad (7)$$

Where:

- $A_{Q,n,rgn}$  = Number of housing units started in quarter  $Q$ , by number of units,  $n$ , and region of the country,  $rgn$ , in thousand units  
 $r_{Q,n}$  = Ratio of structures with number of units,  $n$ , to total number of units by quarter,  $Q$   
 $RS_{t,rgn}$  = Total regional starts from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts  
 $RS_{1,rgn}$  = Regional starts of structures with 1 unit from the 2014 *New Privately Owned Housing Units Started by Purpose and Design* data, in thousand housing starts

Data from the Census report *New Privately Owned Housing Units Authorized Unadjusted Units*<sup>7</sup> is used to calculate a conversion factor to determine the ratio of structures to units in the 5 or more unit category. The conversion factor is calculated by dividing the total number of units in structures with 5 or more units by region<sup>6</sup> by the total number of buildings with 5 or more units by region.<sup>7</sup>

$$CF_5 = \frac{U_{5,rgn}}{B_{5,rgn}} \quad (8)$$

Where:

$$\begin{aligned} CF_{5,rgn} &= \text{Ratio of 5 units or more to the number of buildings with 5 units or more by region, } rgn \\ U_{5,rgn} &= \text{Total number of 5 or more units by region, } rgn \\ B_{5,rgn} &= \text{Total number of buildings with 5 or more units by region, } rgn \end{aligned}$$

Structures started by category are then calculated at a regional level by summing the number of housing unit starts across all four quarters and dividing the by number of units in each building type. For the 3-4 unit type, the number of units per building is 3.5. The value is multiplied by 1,000 because the Census data are in units of thousand building starts.

For buildings with 1, 2, or 3-4 units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{n} \quad (9)$$

Where:

$$\begin{aligned} B_{n,rgn} &= \text{Number of building starts by the unit number category, } n, \text{ and by region, } rgn \\ A_{Q,n,rgn} &= \text{Number of housing units started in quarter } Q, \text{ by number of units, } n, \text{ and region of the country, } rgn, \text{ in thousand units} \\ n &= \text{Number of units per building} \end{aligned}$$

For buildings with 5 or more units:

$$B_{n,rgn} = \frac{(\sum_{Q1}^{Q4} A_{Q,n,rgn}) \times 1,000}{CF_5} \quad (10)$$

Where:

$$\begin{aligned} B_{n,rgn} &= \text{Number of building starts by the unit number category, } n, \text{ and by region, } rgn \\ A_{Q,n,rgn} &= \text{Number of housing units started in quarter } Q, \text{ by number of units, } n, \text{ and region of the country, } rgn, \text{ in thousand units} \\ CF_5 &= \text{Ratio of 5 units or more to the number of buildings with 5 units or more} \end{aligned}$$

Annual county building permit data were purchased from the US Census Bureau for 2014.<sup>8</sup> The 2014 County Level Residential Building Permit dataset has 2014 data to allocate regional housing starts to the county level. This results in county level housing starts by number of units.

The number of building permits for each unit number category by region is calculated by summing the county-level Census data to the region level.

$$BP_{n,rgn} = \sum BP_{n,c} \quad (11)$$

Where:

$$\begin{aligned} BP_{n,rgn} &= \text{Number of building permits by the unit number category, } n, \text{ and by region, } rgn \\ BP_{n,c} &= \text{Number of building permits by the unit number category, } n, \text{ and by county, } c \end{aligned}$$

The ratio of the number of building permits by county to the total number of building permits by region in which the county is located, for each unit number category, is then calculated.

$$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}} \quad (12)$$

Where:

- $R_{BP,c}$  = Ratio building permits,  $BP$ , to total regional building permits in county  $c$
- $BP_{n,c}$  = Number of building permits by the unit number category,  $n$ , and by county,  $c$
- $BP_{n,rgn}$  = Number of building permits by the unit number category,  $n$ , and by region,  $rgn$

The final number of building starts for each unit type category is then calculated at the county-level by multiplying the number of structures started at the regional level and the building permit ratio.

$$B_{n,c} = B_{n,rgn} \times R_{BP,c} \quad (13)$$

Where:

- $B_{n,c}$  = Number of building starts by the unit number category,  $n$ , and by county,  $c$
- $B_{n,rgn}$  = Number of building starts by the unit number category,  $n$ , and by region,  $rgn$
- $R_{BP,c}$  = Ratio building permits,  $BP$ , to total regional building permits in county,  $c$

The number of acres of surface area disturbed by the construction of residential buildings is calculated for apartment buildings, buildings with 2 units, and buildings with 1 unit. Table 3 shows the assumptions used for the surface area disturbed for each unit type. Buildings with unit types of 3-4 and 5 or more are grouped together as apartments in this step.

**Table 3. Surface Soil removed per unit type**

Structure	Acres disturbed
1-Unit	1/4 acre/structure
2-Unit	1/3 acre/structure
Apartment	1/2 acre/structure

The acres of soil disturbed by the construction of residential buildings are calculated for apartment buildings, buildings with 2 units, and buildings with 1 unit.

$$AR_{n,c} = B_{n,c} \times a_n \quad (14)$$

Where:

- $AR_{n,c}$  = Surface soil disturbed by building construction by county,  $c$ , and unit type category,  $n$ , in acres
- $B_{n,c}$  = Number of building starts by the unit number category,  $n$ , and by county,  $c$
- $a_n$  = Acres of surface soil disturbed by each unit type category,  $n$ . See Table 3.

#### ***Acres Disturbed by Road Construction***

The activity data for this source category is the acreage disturbed from new road construction, which is estimated using data from FHWA's *Highway Statistics, State Highway Agency Capital Outlay 2014, Table SF-12A*<sup>9</sup> and FLDOT's *Generic Cost per Mile Models*.<sup>10</sup> From the FHWA table, the following columns are used: New Construction, Relocation, Added Capacity, Major Widening, and Minor Widening. These columns are also differentiated according to the following six classifications:

1. Interstate, urban
2. Interstate, rural
3. Other arterial, urban

4. Other arterial, rural
5. Collectors, urban
6. Collectors, rural

Construction spending for each road type is summed across all construction types to determine the total annual highway spending for each road type.

$$HS_{s,r} = \sum_{ct} S_{s,r} \quad (15)$$

Where:

- $HS_{s,r}$  = Annual highway spending for road type  $r$  in state  $s$ , in dollars  
 $ct$  = Construction type  
 $S_{s,r}$  = Annual spending per construction type for road type  $r$  in state  $s$ , in dollars

State expenditure data are converted to miles of new road and acres disturbed per mile of new road based on conversions obtained from FLDOT. The conversions are shown in

Table 4, and the acres disturbed per mile conversions are calculated by multiplying the total affected roadway width (including all lanes, shoulders, and areas affected beyond the road width) by one mile and converting the resulting land area to acres.

$$RC_{m,s,r} = \frac{HS_{s,r}}{TDM} \quad (16)$$

$$RC_{a,s,r} = RC_{m,s,r} \times ADM \quad (17)$$

Where:

- $RC_{m,s,r}$  = Miles of FHWA road type  $r$  constructed in state  $s$   
 $RC_{a,s,r}$  = Acres of land disturbed for construction of FHWA road type  $r$  in state  $s$   
 $HS_{s,r}$  = Annual highway spending for road type  $r$  in state  $s$   
 $TDM$  = Conversion of dollars spent to road miles constructed, in thousand dollars per mile  
 $ADM$  = Conversion of road miles constructed to acres disturbed, in acres per mile

**Table 4. Spending per Mile and Acres Disturbed per Mile by Highway Type**

Road Type	Thousand Dollars per mile	Total Affected Roadway Width (ft)*	Acres Disturbed per mile
Urban Areas, Interstate	6,895	94	11.4
Rural Areas, Interstate	3,810	89	10.8
Urban Areas, Other Arterials	4,112	63	7.6
Rural Areas, Other Arterials	2,076	55	6.6
Urban Areas, Collectors	4,112	63	7.6
Rural Areas, Collectors	2,076	55	6.6
*Total Affected Roadway Width = (lane width (12 ft) * number of lanes) + (shoulder width * number of shoulders) + area affected beyond road width (25 ft)			

Source: Reference 10.

The acres of land disturbed by road type can then be summed across all road types in a state to calculate the total state-level acreage disturbed due to new road construction.

$$ARC_s = \sum_r RC_{a,s} \quad (18)$$

Where:

- $ARC_s$  = Acres of land disturbed for all road construction in state  $s$
- $RC_{a,s}$  = Acres of land disturbed for construction of FHWA road type  $r$  in state  $s$

Similar to residential construction, county-level building permits data from the U.S. Census Bureau are used to allocate the state-level acres disturbed by road construction to the county.<sup>11</sup> Specifically, the ratio of the county-to state-level number of building starts is calculated and multiplied by the state-level acreage disturbed (from equation 18) to estimate the county-level acreage disturbed by road construction.

$$BFrac_c = \frac{Build_c}{Build_s} \quad (19)$$

$$ARC_c = ARC_s \times BFrac_c \quad (20)$$

Where:

- $BFrac_c$  = The fraction of building starts in county  $c$
- $Build_c$  = The number of building starts in county  $c$
- $Build_s$  = The number of building starts in state  $s$
- $ARC_c$  = Acres of land disturbed for road construction in county  $c$
- $ARC_s$  = Acres of land disturbed for all road construction in state  $s$

### ***Converting Acres Disturbed to Tons of Land Clearing Debris Burned***

The total acres disturbed by all construction types is calculated by summing the acres disturbed from residential, non-residential, and road construction.

$$TAD_c = ANR_c + (\sum AR_{n,c}) + ARC_c \quad (21)$$

Where:

- $TAD_c$  = Total acres disturbed in from nonresidential, residential, and road construction in county  $c$
- $ANR_c$  = Acres disturbed from non-residential construction in county  $c$
- $AR_{n,c}$  = Acres of surface soil disturbed from residential construction in county  $c$  and unit type category  $n$  (summed to one value for residential construction for the county)
- $ARC_c$  = Acres of land disturbed for road construction in county  $c$

Version 2 of the Biogenic Emissions Land cover Database (BELD2) within EPA's Biogenic Emission Inventory System (BEIS) is used to identify the acres of hardwoods, softwoods, and grasses in each county.

Because BELD2 does not contain data on Alaska and Hawaii, the acres of hardwoods, softwoods, and grasses in each county is estimated by using the state-level land cover statistics from the USGS National Land Cover Database on the percent land cover under each vegetation type.<sup>12</sup> These percentages are multiplied by the county area (acres), from the U.S. Census Bureau.<sup>13</sup>

$$A_{AK/HI,c,f} = LA_{AK/HI,c} \times LC_{AK/HI,\%,f} \quad (22)$$

Where:

- $A_{AK/HI,c,f}$  = Total acres of each fuel type,  $f$ , for each county,  $c$ , in Alaska or Hawaii
- $LA_{AK/HI,c}$  = County acres from the U.S. Census Bureau of each fuel type,  $f$ , for each county,  $c$ , in Alaska or Hawaii
- $LC_{AK/HI,\%,f}$  = Land cover percentages for each fuel type (hardwood, softwood, grass) in Alaska or Hawaii

Table 5 presents the average fuel loading factors by vegetation type. The average loading factors for slash hardwood and slash softwood are adjusted by a factor of 1.5 to account for the mass of tree that is below the soil surface that would be subject to burning once the land is cleared.<sup>14</sup> Weighted average county-level loading factors are calculated by multiplying the average loading factors by the percent contribution of each type of vegetation class to the total land area for each county.

$$WFLF_{c,f} = \frac{A_{c,f}}{A_{c,total}} \times LF_f \quad (23)$$

Where:

- $WFLF_{c,f}$  = Weighted average fuel loading factor by for fuel type  $f$  in county  $c$
- $A_{c,f}$  = Acres of land cover in county  $c$ , by fuel type  $f$  (from BELD2 for continental U.S.; from equation 22 for Alaska and Hawaii)
- $A_{c,total}$  = Total acres of land cover of all fuel types in county  $c$
- $LF_f$  = Fuel loading factor by fuel type,  $f$ , in tons/acre, from Table 5

**Table 5. Fuel Loading Factors by Vegetation Type**

Vegetation Type	Unadjusted Average Fuel Loading Factor (Ton/acre)	Adjusted Average Fuel Loading Factor (Ton/acre)
Hardwood	66	99
Softwood	38	57
Grass	4.5	Not Applicable

*Source:* Reference 14, averages of data on page III-19

The weighted average county-level loading factors for each fuel type are then summed across fuel types to calculate a single weighted average loading factor for each county.

$$WFLF_c = \sum_f WFLF_{c,f} \quad (24)$$

Where:

- $WFLF_c$  = Weighted average fuel loading factors for county  $c$
- $WFLF_{c,f}$  = Weighted average fuel loading factor by for fuel type  $f$  in county  $c$

The county-level total acres disturbed are then multiplied by the weighted average loading factor to derive tons of land clearing debris.

$$LCD_c = TAD_c \times WFLF_c \quad (25)$$

Where:

- $LCD_c$  = Land clearing debris in county  $c$ , in tons
- $TAD_c$  = Total acres disturbed in county  $c$
- $WFLF_c$  = Weighted average fuel loading factors for county  $c$

The total land clearing debris burned per county is calculated by multiplying acres of land clearing debris by county by a control factor, based on the percent of urban land from the 2010 U.S. Census data.<sup>13</sup> See Section F for more information on the control factor.

$$BLCD_c = LCD_c \times CF_c \quad (26)$$

Where:

- $BLCD_c$  = Land clearing debris burned in county  $c$ , in tons
- $LCD_c$  = Land clearing debris in county  $c$ , in tons
- $CF_c$  = Control factor. The control factor is 1 for counties with less than 80% urban population and 0 for Colorado or in counties with an urban population of 0.8% or more based on the 2010 U.S. Census data<sup>13</sup> as no burning occurs in these counties. See Section F for more information on the control factor.

#### D. Allocation Procedure

##### *Acres disturbed by Non-residential Construction – County business patterns allocation*

Employment data are obtained from the U.S. Census Bureau's 2014 County Business Patterns (CBP).<sup>15</sup> Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of employment flags is used. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 2362 (non-residential construction).

To gap-fill withheld state-level employment data:

1. State-level data for states with known employment are summed to the national level.
2. State-level known employment is subtracted from the national total reported in the national-level CBP.
3. Each of the withheld states is assigned the midpoint of the employment flag. Table 6 lists the employment flags and midpoints.
4. The midpoints for the states with withheld data are summed to the national-level.
5. An adjustment factor is created by dividing the number of withheld employees (calculated in step 2 of this section) by the sum of the midpoints (step 4)
6. For the states with withheld employment data, the midpoint of the range for that state (step 3) is multiplied by the adjustment factor (step 5) to calculate the adjusted state-level employment for non-residential construction.

These same steps are then followed to fill in withheld data in the county-level business patterns.

1. County-level data for counties with known employment are summed by state.
2. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
3. Each of the withheld counties is assigned the midpoint of the employment flag (Table 6).
4. The midpoints for the counties with withheld data are summed to the state level.
5. An adjustment factor is created by dividing the number of withheld employees (step 2) by the sum of the midpoints (step 4).
6. For counties with withheld employment data, the midpoints (step 3) are multiplied by the adjustment factor (step 5) to calculate the adjusted county-level employment for non-residential construction.

Note that step 5 adjusts all counties within each state with withheld employment data by the same state-based proportion. It is unlikely that actual employment corresponds exactly with this smoothed adjustment method, but this method is the best option given the availability of the data.

**Table 6. Ranges and Midpoints for Data Withheld from State And County Business Patterns**

Employment Flag	Employment Range	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750

Employment Flag	Employment Range	Midpoint
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2014 CBP data for NAICS 2362 (nonresidential construction) in Arizona provided in Table 7.

**Table 7. 2014 CBP for NAICS 2361 in Arizona**

State FIPS	County FIPS	NAICS	Employment Flag	Employment
04	001	2362	A	withheld
04	003	2362	B	withheld
04	005	2362		177
04	007	2362		11
04	009	2362	A	withheld
04	011	2362	H	withheld
04	012	2362	A	withheld
04	013	2362		7,945
04	015	2362		47
04	017	2362		79
04	019	2362		2,220
04	021	2362		112
04	023	2362	A	withheld
04	025	2362		171
04	027	2362		359

1. The total of employees not including withheld counties is 11,121.
2. The state-level CBP reports 13,952 employees for NAICS 2362. The difference is 2,831.
3. Withheld counties are given the midpoint of the employment range. County 001 is given a midpoint of 10 (since employment flag A is 0 – 19) and County 011 is given a midpoint of 3,750 (since employment flag H is 2,500 – 4,999).
4. State total for these all withheld counties is 3,850.
5.  $2,831/3,850 = 0.74$ .
6. The adjusted employment for county 001 is  $10 \times 0.74 = 7.35$  employees. County 011 has an adjusted employment of  $3,750 \times 0.74 = 2,757.47$  employees.

The county-level employment data are used to allocate the national-level non-residential construction spending data to the county-level (see equation 1).

#### ***Acres disturbed by Residential Construction – Building permits allocation***

Annual county building permit data were purchased from the U.S. Census Bureau for 2014<sup>8</sup> and used to allocate regional housing starts to the county level. This results in county level housing starts by number of units. See equations 11-13 in section C.

#### ***Acres Disturbed by Road Construction – Building permits allocation***

State-level estimates of acres disturbed by road construction is distributed to the counties based on county-level data on residential building starts from the U.S. Census Bureau.<sup>11</sup> See equations 19 and 20 in section C.

## E. Emissions Factors

Emissions factors are reported in Table 8 below. Emissions factors for CAPs and HAPs are from the AP-42 and U.S. EPA Emissions Inventory Improvement Program.<sup>1617</sup> The PM<sub>25</sub> to PM<sub>10</sub> emissions factor ratio for brush burning (0.7709) is multiplied by the PM<sub>10</sub> emissions factors for land clearing debris burning to develop PM<sub>25</sub> emissions factors. Emissions factors for HAPs are from an EPA Control Technology Center report.<sup>18</sup>

**Table 8. Emissions Factors for Open Burning of Land Clearing Debris (SCC 2610000500)**

Pollutant	Pollutant Code	Emissions Factor (lb/ton)	Emission Factor Reference
VOC	VOC	11.3	Reference 16, Table 2.5-5, a
NOX	NOX	4.0	Reference 16, Table 2.5-5, b
CO	CO	164.8	Reference 17, Table 16.4-2, c
PM <sub>10</sub> -FIL	PM <sub>10</sub> -FIL	20.4	Reference 17, Table 16.4-2, c
PM <sub>25</sub> -FIL	PM <sub>25</sub> -FIL	18.6	Reference 17, Table 16.4-2, c
PM <sub>10</sub> -PRI	PM <sub>10</sub> -PRI	20.4	Reference 17, Table 16.4-2, c
PM <sub>25</sub> -PRI	PM <sub>25</sub> -PRI	18.6	Reference 17, Table 16.4-2, c
Cumene	98828	0.012	Reference 16, Table 16.4-3, d
Ethyl Benzene	100414	0.048	Reference 16, Table 16.4-3, d
Phenol	108952	0.115	Reference 16, Table 16.4-3, d
Styrene	100425	0.102	Reference 16, Table 16.4-3, d

- Average of factors for forest residues.
- Emissions factor is from footnote to Table 2.5-5
- Average of factors from Table 16.4-2 except for last two rows (test burn with blower)
- Average of factors from Table 16.4-3 except for last two columns (test burn with blower)

## F. Controls

Controls for land clearing debris burning are generally in the form of a ban on open burning of waste in a given municipality or county. Counties that are more than 80% urban by land area determined by the 2010 U.S. Census data,<sup>13</sup> are assumed not to practice any open burning of land clearing debris. Therefore, CAP and HAP emissions from open burning of land clearing debris are zero in these counties.

Additionally, it is assumed that even in counties that are less than 80% urban by land area, open burning will only be practiced in areas that are rural. Therefore, the total land clearing debris burned per county (from equation 26) will be scaled based on the fraction of rural land area in each county from the 2010 Census.

$$BLCD_{r,c} = BLCD_c \times \frac{RLand_c}{TLand_c} \quad (27)$$

Where:

- $BLCD_{r,c}$  = Land clearing debris burned in rural areas by county,  $c$ , in tons  
 $BLCD_c$  = Land clearing debris burned by county,  $c$ , in tons  
 $RLand_c$  = Amount of rural land by land area in county  $c$   
 $TLand_c$  = Total amount of land in county  $c$

Further controls on burning (i.e., burn bans in rural areas) are represented by multiplying the land clearing debris burned in rural counties by a burn ban's effectiveness; effectiveness is a value between 0 and 1.

$$BLCD_{r,c} = BLCD_{r,c} \times BE_c \quad (28)$$

Where:

$BLCD_{r,c}$  = Land clearing debris burned in rural areas by county,  $c$ , in tons  
 $BE_c$  = Burn ban effectiveness in county  $c$

In this methodology, burn ban effectiveness is represented by a single value between 0 and 1 that is multiplied by the amount of land clearing debris burned in the rural areas of each county. In practice, the burn ban effectiveness is a function of both a rule's penetration and effectiveness. Rule penetration refers to the extent to which a regulation covers emissions for a specified controlled area, and effectiveness concerns the ability of the regulatory program to achieve emissions reductions compared to full compliance. By default the burn ban effectiveness for each county is 1 (i.e. the methodology assumes no burn bans in each county), although this may be updated by state, local, or tribal agencies.

## G. Emissions

County-level criteria pollutant and HAP emissions are calculated by multiplying the mass of land clearing debris burned in rural areas per year (from equation 28) by an emissions factor from Table 8.

$$E_{c,p} = BLCD_{r,c} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lb}} \quad (29)$$

Where:

$E_{c,p}$  = Emissions by county,  $c$ , and pollutant,  $p$ , in tons  
 $BLCD_{r,c}$  = Land clearing debris burned in rural areas by county,  $c$ , in tons  
 $EF_p$  = Emissions factor by pollutant,  $p$ , in pounds/ton

## H. Point Source Subtraction

There are no point source-specific SCCs for open burning of land clearing debris; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 9 shows sample calculations for PM25-PRI emissions from open burning of land clearing debris in McLean County, Illinois. Equations 5 through 7 use the first quarter (Q1) of 2014 for 2-unit structures as an example. However these calculations would need to be repeated to calculate values for all 4 quarters for all 3 unit sizes. Note that structures with 5 or more units and structures with 1 unit with or without a basement have additional steps not shown in the sample calculations here. Equations 15 through 20 use urban roads as an example for acres of land disturbed from road construction. For full calculations of acres of land disturbed from road construction the calculations for rural roads would also need to be incorporated.

**Table 9. Sample calculations for PM25-PRI emissions from open burning of land clearing debris in McLean County, IL**

Eq. #	Equation	Values for McLean County, IL	Result
1	$EmpFr_c = \frac{Emp_c}{Emp_{US}}$	$\frac{140 \text{ nonres construction employees}}{581,963 \text{ nonres construction employees}}$	0.000241 fraction on non-residential construction employees in McLean County, IL

Eq. #	Equation	Values for McLean County, IL	Result
2	$CS_c = EmpFr_c \times CS_{US}$	0.000241 <i>fraction of employees</i> $\times \$347,666$ <i>million in nonres construction spending in the US</i>	\$83.79 million in non-residential construction spending in McLean County, IL
3	$Apd_{2014} = \frac{2 \text{ acres}}{\$1 \text{ million}} \times \frac{PD_{1992}}{PD_{2014}}$	$\frac{2 \text{ acres disturbed}}{\$1 \text{ million}} \times \frac{57 \text{ in 1992}}{113 \text{ in 2014}}$	1.009 acres disturbed per million dollars spent on non-residential construction spending, nationally
4	$ANR_c = CS_c \times Apd_y$	$\$83.79 \text{ million} \times 1.009 \frac{\text{acres disturbed}}{\text{million \$}}$	84.4 acres disturbed from non-residential construction in McLean County, IL
5	$S_{Q,n} = \left( \frac{U_n}{U_t} \right) \times S_{Q,2-4}$	$\left( \frac{14 \text{ two unit housing starts in 2002}}{38 \text{ total housing starts in 2002}} \right) \times$ $2 \text{ two to four unit housing starts in Q1 2014}$	0.74 thousand housing starts for 2-unit structures in Q1 2014, nationally
6	$r_{Q,n} = \frac{S_{Q,n}}{S_{Q,t}}$	$\frac{0.74 \text{ two unit housing starts}}{72 \text{ two or more unit housing starts}}$	0.01 ratio of buildings with 2 units to all units greater than 2 for Q1 2014, nationally
7	$A_{Q,n,rgn} = r_{Q,n} \times (RS_t - RS_1)$	0.01 $\times (21 \text{ total Q1 housing starts in Midwest} - 14 \text{ one unit housing starts in Midwest})$	0.07 thousand housing starts for 2-unit structures for Q1 2014 in the Midwest
8	$CF_5 = \frac{U_{5,rgn}}{B_{5,r}}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings
9	$B_{n,rgn} = \frac{(\sum A_{Q,n,rgn}) \times 1,000}{n}$	$\frac{0.775 \text{ two unit structures} \times 1,000}{2 \text{ units per building}}$	388 2-unit structures constructed in the Midwest
10	$B_{n,rgn} = \frac{(\sum A_{Q,n,rgn}) \times 1,000}{CF_5}$	N/A	Equation is for 5 or more unit buildings; example is for 2-unit buildings

Eq. #	Equation	Values for McLean County, IL	Result
11	$BP_{n,rgn} = \sum BP_{n,c}$	$\sum$ <i>Midwest two unit building permits</i>	1,571 2-unit structure building permits in the Midwest
12	$R_{BP,c} = \frac{BP_{n,c}}{BP_{n,rgn}}$	$\frac{1 \text{ McLean County building permits}}{1,571 \text{ Midwest building permits}}$	0.000637 ratio of county-level building permits to regional-level building permits in McLean County, IL
13	$B_{n,c} = B_{n,rgn} \times R_{BP,c}$	388 <i>two unit building starts in the Midwest</i> $\times$ 0.000637	0.25 total 2-unit structure building starts for McLean County, IL
14	$AR_{n,c} = B_{n,c} \times a_n$	0.25 <i>two unit structures</i> $\times$ 0.33 <i>acres per structure</i>	0.08 acres surface soil disturbed by 2-unit structures in McLean County, IL
15	$HS_{s,r} = \sum_{ct} S_{s,r}$	\$20,399,000 + \$33,029,000 + \$93,892,000	\$147,320,000 spent on urban interstate construction in IL
		\$58,519,000 + \$2,626,000 + \$35,1367,000 + \$206,057,000 + \$17,193,000	\$319,532,000 spent on urban other arterial construction in IL
		\$16,093,000 + \$338,000 + \$355,000	\$16,786,000 spend on urban collector construction in IL
16	$RC_{m,s,r} = \frac{HS_{s,r}}{TDM}$	$\frac{\$147,320,000}{6,895,000 \text{ \$ per mile}}$	21.4 miles of urban interstate constructed in IL
		$\frac{\$319,532,000}{4,112,000 \text{ \$ per mile}}$	77.7 miles of urban other arterial constructed in IL
		$\frac{\$16,786,000}{4,112,000 \text{ \$ per mile}}$	4.1 miles of urban collector constructed in IL
17	$RC_{a,s,r} = RC_{m,s,r} \times ADM$	21.4 <i>miles</i> $\times$ 11.4 <i>acres per mile</i>	242.9 acres disturbed from urban interstate construction in IL

Eq. #	Equation	Values for McLean County, IL	Result
		$77.7 \text{ miles} \times 7.6 \text{ acres per mile}$	589.6 acres disturbed from urban other arterial construction in IL
		$4.1 \text{ miles} \times 7.6 \text{ acres per mile}$	31 acres disturbed from urban collector construction in IL
18	$ARC_s = \sum_r RC_{a,s}$	$242.9 \text{ acres} + 589.6 \text{ acres} + 31 \text{ acres}$	863.5 acres disturbed from urban road construction in IL
19	$B\text{Frac}_c = \frac{\text{Build}_c}{\text{Build}_s}$	$\frac{246 \text{ building starts in McLean County}}{20,578 \text{ building starts in IL}}$	0.012 fraction of building starts in McLean County, IL
20	$ARC_c = ARC_s \times B\text{Frac}_c$	$863.5 \text{ acres} \times 0.012$	10.4 acres disturbed from urban road construction in McLean County, IL
21	$TAD_c = ANR_c + (\sum S_{n,c}) + ARC_c$	$84.4 \text{ acres} + 62.02^* \text{ acres} + 13.95^{**} \text{ acres}$ * note that the value for residential construction is for all unit types, not just 2-unit buildings as shown in example above ** note the value for road construction is for all road types, not just urban roads as shown in the example above	160.4 total acres disturbed in McLean County, IL
22	$A_{AK/HI,c,f} = LA_{AK/HI,c} \times LC_{AK/HI,\%,f}$	N/A	Equation is for Alaska or Hawaii
23	$WFLF_{c,f} = \frac{A_{c,f}}{A_{total}} \times LF_f$	$\frac{17,516 \text{ acres}}{758,793 \text{ acres}} \times 99 \text{ tons per acre}$	2.3 tons/ acre weighted factor for hardwood fuel in McLean County, IL
		$\frac{0 \text{ acres}}{758,793 \text{ acres}} \times 57 \text{ tons per acre}$	0.0 tons/ acre weighted factor for softwood fuel in McLean County, IL
		$\frac{741,276 \text{ acres}}{758,793 \text{ acres}} \times 4.5 \text{ tons per acre}$	4.4 tons/ acre weighted factor for grass fuel in McLean County, IL

Eq. #	Equation	Values for McLean County, IL	Result
24	$WFLF_c = \sum WFLF_{c,f}$	$2.3 \frac{\text{tons}}{\text{acre}} + 0.0 \frac{\text{tons}}{\text{acre}} + 4.4 \frac{\text{tons}}{\text{acre}}$	6.7 tons/acre weighted factor for all fuels in McLean County, IL
25	$LCD_c = TAD_c \times WFLF_c$	$160.4 \text{ acres} \times 6.7 \frac{\text{tons}}{\text{acre}}$	1,071 tons of land clearing debris in McLean County, IL
26	$BLCD_c = LCD_c \times CF_c$	$1,071 \text{ tons} \times 1 \text{ control factor}$	1,071 tons of land clearing debris burned in McLean County, IL
27	$BLCD_{r,c} = BLCD_c \times \frac{RLand_c}{TLand_c}$	$1,071 \text{ tons} \times \frac{2,923,414,473 \text{ m}^2 \text{ rural land}}{3,064,933,852 \text{ m}^2 \text{ total land}}$	1,022 tons of land clearing debris burned in rural areas in McLean County, IL
28	$E_{c,p} = BLCD_{r,c} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	$1,022 \text{ tons} \times 13.1053 \frac{\text{lb}}{\text{ton}} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	6.7 tons PM25-PRI emissions in McLean County, IL

## J. Changes from 2014 Methodology

There main change to this methodology from the methodology used to calculate the 2014 v2 NEI is that the estimated amount of land clearing debris in each county is multiplied by the fraction of rural land area in each county. This step was not done in the methodology used for the 2014 v2 NEI.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

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- <sup>17</sup> U.S. Environmental Protection Agency. 2001. Emission Inventory Improvement Program, Volume III, Chapter 16, Open Burning, [https://www.epa.gov/sites/production/files/2015-08/documents/iii16\\_apr2001.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/iii16_apr2001.pdf)
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## OPEN BURNING – RESIDENTIAL HOUSEHOLD WASTE

### A. Source Category Description

Open burning of residential household waste (RHW) is the purposeful burning of RHW in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for RHW burning are a function of the amount of waste burned per year. In 2014, open burning of RHW in the U.S., Puerto Rico, and U.S. Virgin Islands resulted in approximately 18,614 tons of VOC emissions, 292,400 tons of CO emissions, 87,300 tons of primary PM<sub>25</sub> emissions, and 95,327 tons of primary PM<sub>10</sub> emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610030000	Waste Disposal, Treatment, and Recovery	Open Burning	Residential	Household Waste (use 26-10-000-xxx for Yard Wastes)

Burning of yard waste is included in SCC 2610000100 and SCC 2610000400; therefore, it is not part of residential household waste.

### B. Overview of Calculations

The calculations for estimating the emissions from the burning of RHW involve first estimating the amount of combustible waste generated in each county. The amount of waste generated in the U.S. is available from the EPA report, *Advancing Sustainable Materials Management: 2014 Fact Sheet*.<sup>1</sup> The amount of county-level RHW burned is estimated by calculating the per capita amount of RHW generated using the national data from EPA, and multiplying that by the number of people likely to burn waste in each county. The number of people likely to burn waste is based on the rural population in each county from the 2010 census. To estimate emissions from RHW burning, pollutant emissions factors are multiplied by the amount of combustible waste burned. Emissions factors for PM, VOC, and HAPs are from the literature, whereas emissions factors for CO, NOX, and SO<sub>2</sub> are adjusted based on the ratio of total waste to combustible waste. Sources of data and calculations for the amount of waste generated are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from open burning of RHW is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of RHW burned in each county, which is estimated using data the EPA report *Advancing Sustainable Materials Management: 2014 Fact Sheet*.<sup>1</sup> The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2014.

Table 1 shows the total national-level waste generated by type and the corresponding per capita values. Per capita values of RHW subject to burning were developed based on EPA's total amount of waste generated in 2014. According to the 2010 version of the same EPA report, residential waste generation accounts for 55-65% of the total waste from the residential and commercial sectors;<sup>2</sup> for the per capita calculation, the median value of 60% of total waste generated is assumed. This number is multiplied by the sums of the total and combustible waste, respectively. Each number is then divided by the U.S. population in 2014 (319 million people)<sup>3</sup> to determine separate per capita values for total and combustible waste. Note that yard waste is not included in either per capita value as emissions from the burning of yard waste are calculated in separate SCCs.

$$PC_{c\text{waste}} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}} \quad (1)$$

$$PC_{t\text{waste}} = \frac{\sum_T W \times 0.60}{P_{US}} \quad (2)$$

Where:

- $PC_{c\text{waste}}$  = Per capita value of combustible waste in the U.S., in tons per person  
 $PC_{t\text{waste}}$  = Per capita value of total waste in the U.S., in tons per person  
 $Com$  = Types of combustible waste (not including yard waste)  
 $T$  = All types of waste (not including yard waste)  
 $W$  = Annual weight of waste, in million tons  
 $P_{y,US}$  = Population of the U.S. for year of inventory, in million people

The per capita value of combustible household waste is estimated to be 0.354 tons generated per person in 2014, and the per capita value of total waste is 0.420 tons generated per person.

**Table 1. Annual Waste Generated in the U.S. in 2014**

Material	Weight Generated (million tons)	Tons Generated per Person	
		Total RHW	Combustible RHW
Paper	68.61	0.129	0.129
Glass	11.48	0.022	0
<u>Metals</u>			
Steel	17.69	0.033	0.0
Aluminum	3.53	0.007	0.0
Other nonferrous	2.04	0.004	0.0
<i>Total Metals</i>	<i>23.26</i>	<i>0.044</i>	<i>0.0</i>
Plastics	32.25	0.061	0.061
Rubber/leather	8.21	0.015	0.015
Textiles	16.22	0.031	0.031
Wood	16.12	0.030	0.030
Other	4.44	0.008	0.008
<i>Total Materials</i>	<i>180.59</i>	<i>0.340</i>	<i>0.274</i>
<u>Other wastes</u>			
Food	38.40	0.072	0.072
Yard	34.50	0.0	0.0
Miscellaneous inorganic	3.97	0.007	0.007
<i>Total Other</i>	<i>76.87</i>	<i>0.080</i>	<i>0.080</i>
<b>TOTAL RHW</b>	<b>257.46</b>	<b>0.420</b>	<b>0.354</b>

Source: Reference 1, Table 1

As open burning of RHW is generally not practiced in urban areas, only the rural population in each county is assumed to practice open burning. The rural and urban populations are taken from 2010 U.S. Census data for each county.<sup>4</sup> It is assumed that 24% of the rural population burns RHW.<sup>5</sup>

$$PBurn_c = RPop_c \times 0.24 \quad (3)$$

Where:

- $RPop_c$  = Rural population in county  $c$  in 2010  
 $PBurn_c$  = Population likely to burn RHW in county  $c$

The number of people likely to burn waste in each county (from equation 3) is then used with the values of per capita household waste subject to burning (from equations 1 and 2) to determine the amount of household RHW burned.

$$CWst_c = PBurn_c \times PC_{c_{waste}} \quad (4)$$

Where:

- $CWst_c$  = Annual combustible RHW burned in county c, in tons
- $PBurn_c$  = Population likely to burn in county c
- $PC_{c_{waste}}$  = Per capita value of combustible waste in the U.S., in tons per person

#### D. Allocation Procedure

National values for the amount of waste generated are distributed to the counties based on rural population, as described in Section C.

#### E. Emissions Factors

Emissions factors for open burning of RHW are reported in Table 3. The emissions factors for CO, NOX, PM, SO<sub>2</sub>, and VOC and some HAPs are from AP-42<sup>6</sup> and the EPA report *Evaluation of Emissions from the Open Burning of Household Waste in Barrels*.<sup>7</sup> Emissions factors for HAPs are from an EPA Office of Research and Development report<sup>8</sup> and a Minnesota Pollution Control Agency Report.<sup>9</sup> For HAP emissions factors from the EPA Control Technology Center report,<sup>7</sup> the emissions factors are based on an average of emissions factors for non-recyclers. This assumes that a person burning RHW in their yard is more likely to be a non-recycler than an avid recycler.

The emissions factors for PM, VOC, and HAPs were developed based on the amount of combustible waste burned. Emissions factors for CO, NOX, and SO<sub>2</sub> were developed based on the amount of total waste burned; therefore, these factors need to be adjusted to be used with the values of combustible waste burned. This is accomplished by multiplying the emissions factors by a ratio of the total per capita waste to combustible per capita waste in 2014.

$$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{c_{waste}}} \quad (5)$$

Where:

- $EF_p$  = Emission factor for pollutant p, in lbs. of pollution per ton of waste burned
- $Com$  = Types of combustible waste (not including yard waste)
- $T$  = All types of waste (not including yard waste)
- $PC_{c_{waste}}$  = Per capita value of combustible waste in the US, in tons per person
- $PC_{twaste}$  = Per capita value of total waste in the US, in tons per person

#### F. Controls

Controls for residential household waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. However, literature suggests that burn bans are not 100% effective. It is therefore assumed that approximately 25% of the residents that may burn trash in the yard would burn waste even if a ban is in place. For counties that have burn bans, the assumption is applied by multiplying 0.25 by the annual waste burned. Currently no counties are assumed to have burn bans in place.

$$\begin{aligned} & \text{If county } c \text{ has a burn ban} \\ & \text{Then } CWst_c = CWst_c \times 0.25 \end{aligned} \quad (6)$$

Where:

- $CWst_c$  = Annual combustible RHW burned in county c, in tons

#### G. Emissions

The annual amount of combustible RHW burned in each county is multiplied by the emissions factors listed in Table 3 to estimate emissions.

$$E_{p,c} = CWst_c \times EF_{p,Com} \quad (7)$$

Where:

- $E_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$   
 $EF_{p,Com}$  = Emission factor for pollutant  $p$ , in lbs. of pollution per ton of combustible waste burned  
 $CWst_c$  = Annual combustible RHW burned in county  $c$ , in tons

## H. Point Source Subtraction

There are no point source-specific SCCs for open burning of RHW; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 2 lists sample calculations to determine the CO and VOC emissions from open burning in Autauga County, Alabama.

**Table 2. Sample calculations for CO and VOC emissions from open burning in Autauga County, AL.**

Eq. #	Equation	Values for Autauga County, AL	Result
1	$PC_{cWaste} = \frac{\sum_{Com} W \times 0.60}{P_{y,US}}$	$\frac{188.22 \text{ million tons of waste} \times 0.60}{318.85 \text{ million people}}$	0.354 tons combustible waste per person per year
2	$PR_{twaste} = \frac{\sum_{NC} W \times 0.60}{P_{US}}$	$\frac{222.96 \text{ million tons of waste} \times 0.60}{318.85 \text{ million people}}$	0.420 tons total waste per person per year
3	$PBurn_c = RPop_c \times 0.24$	$22,921 \text{ people} \times 0.24$	5,501 people likely to burn in Autauga County, AL
4	$CWst_c = PBurn_c \times PC_{cWaste}$	$5,501 \text{ people} \times 0.354 \text{ tons combustible waste per person}$	1,947.4 tons of combustible waste burned in Autauga County, AL
5	$EF_{p,Com} = EF_{p,T} \times \frac{PC_{twaste}}{PC_{cWaste}}$	$85 \text{ lbs. per ton} \times \frac{0.42 \text{ tons per person}}{0.354 \text{ tons per person}}$	100.8 lbs. of CO per ton of combustible waste burned
6	<i>If county c has a burn ban Then <math>CWst_c = CWst_c \times 0.25</math></i>	N/A	Autauga County, AL does not have a burn ban
7	$E_{p,c} = CWst_c \times EF_{p,Com}$	$1,947.4 \text{ tons} \times 100.8 \text{ lbs. per ton}$	98.14 tons CO emissions from burning of RHW in Autauga County, AL
		$1,947.4 \text{ tons} \times 8.46 \text{ lbs. per ton}$	8.23 tons VOC emissions from burning of RHW in Autauga County, AL

## J. Changes from 2014 Methodology

The 2017 emissions inventory methodology for RHW burning includes changes to the method for determining population likely to burn, and changes to the emissions factors for CO, NOX, and SO<sub>2</sub>. The 2014 v2 NEI methodology determined the population likely to burn by identifying the rural and “like rural” population in each county in 2010 and using the fraction of 2010 rural and like rural population to total population in order to determine the rural population in 2014. The 2017 methodology only uses the 2010 rural population to determine the population likely to burn.

Additionally the 2014 v2 NEI methodology used emissions factors for CO, NOX, and SO<sub>2</sub> that corresponded to the amount of combustible plus non-combustible waste burned. The 2017 methodology uses a ratio of combustible to total waste burned in order to adjust the CO, NOX, and SO<sub>2</sub> emissions factors to be used with the amount of combustible waste burned.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data, since 2014 Census Data does not exist for the U.S. Virgin Islands.

## L. References

- <sup>1</sup> U.S. Environmental Protection Agency. 2016. *Advancing Sustainable Materials: 2014 Fact Sheet*, "Table 1. Generation, Recovery and Discards of Materials in MSW, 2013(in millions of tons and percent of generation of each material)". <https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and-figures-report>
- <sup>2</sup> U.S. Environmental Protection Agency. 2011. *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*, p. 4. [https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw\\_2010\\_factsheet.pdf](https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw_2010_factsheet.pdf)
- <sup>3</sup> U.S. Census Bureau. *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2014 Populations Estimates*, [https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP\\_2016\\_PEPANNRES&src=pt](https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2016_PEPANNRES&src=pt)
- <sup>4</sup> U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1. [http://www2.census.gov/census\\_2010/04-Summary\\_File\\_1/](http://www2.census.gov/census_2010/04-Summary_File_1/).
- <sup>5</sup> Environment Canada. 2001. “Household Garbage Disposal and Burning.” Prepared by Environics Research Group.
- <sup>6</sup> U.S. Environmental Protection Agency. 1995. *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Section 2.5 Open Burning*. Research Triangle Park, NC.
- <sup>7</sup> U.S. Environmental Protection Agency. 1997. “Evaluation of Emissions from the Open Burning of Household Waste in Barrels.” EPA-600/R-97-134a. [https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?dirEntryID=115129](https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=115129)
- <sup>8</sup> U.S. Environmental Protection Agency. 2002. “Emissions of organic air toxics from open burning: a comprehensive review.” EPA-600/R-02-076. <https://nepis.epa.gov/Exec/QueryNET.exe/P1001G31.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C00thru05%5CTxt%5C00000016%5CP1001G31.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL>
- <sup>9</sup> Babineau, I., Wu, C.Y., Jackson, A., Minnesota Pollution Control Agency. 2016. “Emission Factor Development for Mercury Emitted From Municipal Solid Waste during Processing and Handling.” In proceedings of the

109<sup>th</sup> Annual Meeting of the A&WMA, New Orleans, LA.

**Table 3. Emissions Factors for Open Burning of RHW**

<b>Pollutant</b>	<b>Pollutant Code</b>	<b>Emission Factor (original)</b>	<b>Emission Factor Units (original)</b>	<b>Emission Factor (converted)</b>	<b>Emission Factor Units (converted)</b>	<b>Reference &amp; Table No.</b>
Carbon Monoxide	CO	85	lbs./ton	100.61	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
Nitrogen Oxides	NOX	6	lbs./ton	7.10	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
PM10-FIL	PM10-FIL	18.76	g/kg	38	lbs./ton	Reference 7 (average of non-recyclers)
PM10-PRI	PM10-PRI	18.76	g/kg	38	lbs./ton	Reference 7 (average of non-recyclers)
PM25-FIL	PM25-FIL	17.44	g/kg	34.8	lbs./ton	Reference 7 (average of non-recyclers)
PM25-PRI	PM25-PRI	17.44	g/kg	34.8	lbs./ton	Reference 7 (average of non-recyclers)
Sulfur Oxides	SO2	1	lbs./ton	1.184	lbs./ton	Reference 6, Table 2.5-1; original factor based on total waste; converted factor based on combustible waste
VOC	VOC	-	mg/kg	7.409	lbs./ton	Reference 8, Table 3-6 (sum of HAP VOC emissions factors)
1,2,4-trichlorobenzene	120821	0.1	mg/kg	2.00E-04	lbs./ton	Reference 8, Table 3-6
1,4-dichlorobenzene	106467	0.03	mg/kg	6.00E-05	lbs./ton	Reference 8, Table 3-6
2,4,6-Trichlorophenol	88062	0.19	mg/kg	3.80E-04	lbs./ton	Reference 8, Table 3-6
2-Methylnapthalene	91576	8.53	mg/kg	1.70E-02	lbs./ton	Reference 8, Table 3-6
Acenaphthene	83329	0.64	mg/kg	1.28E-03	lbs./ton	Reference 8, Table 3-6
Acenaphthylene	208968	7.34	mg/kg	1.47E-02	lbs./ton	Reference 8, Table 3-6
Acetaldehyde	75070	428.4	mg/kg	8.55E-01	lbs./ton	Reference 8, Table 3-6
Acetophenone	98862	4.69	mg/kg	9.36E-03	lbs./ton	Reference 8, Table 3-6
Acrolein	107028	26.65	mg/kg	5.32E-02	lbs./ton	Reference 8, Table 3-6
Anthracene	120127	1.3	mg/kg	2.59E-03	lbs./ton	Reference 8, Table 3-6
Benz[a]anthracene	56553	1.51	mg/kg	3.01E-03	lbs./ton	Reference 8, Table 3-6
Benzene	71432	979.75	mg/kg	1.96E+00	lbs./ton	Reference 8, Table 3-6
Benzo[a]pyrene	50328	1.4	mg/kg	2.79E-03	lbs./ton	Reference 8, Table 3-6
1,3-Butadiene	106990	141.25	mg/kg	2.82E-01	lbs./ton	Reference 8, Table 3-6
Benzo[b]fluoranthene	205992	1.86	mg/kg	3.71E-03	lbs./ton	Reference 8, Table 3-6
Benzo[g,h,i.]Perylene	191242	1.3	mg/kg	2.59E-03	lbs./ton	Reference 8, Table 3-6
Benzo[k]fluoranthene	207089	0.67	mg/kg	1.34E-03	lbs./ton	Reference 8, Table 3-6
Bis (2-Ethylhexyl) Phthalate	117817	23.79	mg/kg	4.75E-02	lbs./ton	Reference 8, Table 3-6
Chloromethane	74873	163.25	mg/kg	3.26E-01	lbs./ton	Reference 8, Table 3-6
Chrysene	218019	1.8	mg/kg	3.59E-03	lbs./ton	Reference 8, Table 3-6
Cresol/Cresylic Acid (Mixed Isomers)	1319773	68.77	Mg/kg	1.37E-01	lbs./ton	Reference 8, table 3-6
Dibenzo[a,h]anthracene	53703	0.27	mg/kg	5.40E-04	lbs./ton	Reference 8, Table 3-6
Dibutyl Phthalate	84742	3.45	mg/kg	6.89E-03	lbs./ton	Reference 8, Table 3-6
Ethyl Benzene	100414	181.75	mg/kg	3.63E-01	lbs./ton	Reference 8, Table 3-6
Fluoranthene	206440	2.77	mg/kg	5.53E-03	lbs./ton	Reference 8, Table 3-6
Fluorene	86737	2.99	mg/kg	5.97E-03	lbs./ton	Reference 8, Table 3-6
Formaldehyde	50000	443.65	mg/kg	8.85E-01	lbs./ton	Reference 8, Table 3-6
Dibenzofuran	132649	3.64	mg/kg	7.26E-03	lbs./ton	Reference 8, Table 3-6
Hexachlorobenzene	118741	0.04	mg/kg	8.00E-05	lbs./ton	Reference 8, Table 3-6

Pollutant	Pollutant Code	Emission Factor (original)	Emission Factor Units (original)	Emission Factor (converted)	Emission Factor Units (converted)	Reference & Table No.
Indeno[1,2,3-c,d]pyrene	193395	1.27	mg/kg	2.53E-03	lbs./ton	Reference 8, Table 3-6
Isophorone	78591	9.25	mg/kg	1.85E-02	lbs./ton	Reference 8, Table 3-6
Methylene Chloride	75092	17	mg/kg	3.39E-02	lbs./ton	Reference 8, Table 3-6
Mercury	7439976	8.74E-04	lbs./ton	-	-	Reference 9
Naphthalene	91203	11.36	mg/kg	2.27E-02	lbs./ton	Reference 8, Table 3-6
Pentachloronitrobenzene	82688	0.01	mg/kg	2.00E-05	lbs./ton	Reference 8, Table 3-6
Phenanthrene	85018	5.33	mg/kg	1.06E-02	lbs./ton	Reference 8, Table 3-6
Phenol	108952	112.66	mg/kg	2.25E-01	lbs./ton	Reference 8, Table 3-6
Polychlorinated Biphenyls (PCBs)	1336363	0.126	mg/kg	2.51E-04	lbs./ton	Reference 8, Table 3-6
Propionaldehyde	123386	112.6	mg/kg	2.25E-01	lbs./ton	Reference 8, Table 3-6
Pyrene	129000	3.18	mg/kg	6.35E-03	lbs./ton	Reference 8, Table 3-6
Styrene	100425	527.5	mg/kg	1.05E+00	lbs./ton	Reference 8, Table 3-6
Toluene	108883	372	mg/kg	7.42E-01	lbs./ton	Reference 8, Table 3-6
Xylenes (Mixed Isomers)	1330207	38	mg/kg	7.58E-02	lbs./ton	Reference 8, Table 3-6

- Emissions factor for 1,4-Dichlorobenzene is reported as <1 mg/kg. The factor used for this methodology assumes that the actual value is 0.333 mg/kg.
- Emissions factor for Pentachlorophenol is reported as <0.0025 and <0.0018 g/kg. The factor used for this methodology assumes that the actual value is 5.3E-05 g/kg.

## OPEN BURNING – YARD WASTE-LEAF AND BRUSH SPECIES

### A. Source Category Description

Open burning of yard waste is the purposeful burning of leaf and brush species in outdoor areas. Criteria air pollutant (CAP) and hazardous air pollutant (HAP) emission estimates for leaf and brush waste burning are a function of the amount of waste burned per year. In 2014, open burning of yard waste in the U.S., Puerto Rico, and U.S. Virgin Islands resulted in approximately 5,035 tons of VOC emissions, 4,470 tons of primary PM10 emissions, and 3,446 tons of primary PM25 emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2610000100	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Leaf Species Unspecified
2610000400	Waste Disposal, Treatment, and Recovery	Open Burning	All Categories	Yard Waste – Brush Species Unspecified

### B. Overview of Calculations

The calculations for estimating the emissions from the burning of yard waste involve first estimating the amount of leaf and brush waste generated in each county. The amount of waste generated in the U.S. is available from the EPA report *Advancing Sustainable Materials Management: 2014 Fact Sheet*.<sup>1</sup> The amount of county-level yard waste burned is estimated by calculating the per capita amount of leaf and brush waste generated using the national data from the EPA report, and multiplying that by the number of people likely to burn waste in each county. The number of people likely to burn waste is based on the rural population in each county from the 2010 census. The total amount of yard waste burned is multiplied by emissions factors for criteria air pollutants (CAPs) and hazardous air pollutants (HAPs) to estimate emissions of these pollutants from yard waste burning. Sources of data and calculations for the amount of waste generated are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from open burning of yard waste is discussed in section G.

### C. Activity Data

The activity data for this source category is the amount of leaf and brush waste generated, which is estimated using data the EPA report *Advancing Sustainable Materials Management: 2014 Fact Sheet*.<sup>1</sup> The report presents the total mass of waste generated from the residential and commercial sectors in the United States by type of waste for the calendar year 2014.

Table 1 shows the national-level yard waste generated and the corresponding per capita values. The per capita value of yard waste subject to burning was developed based on EPA's total amount of waste generated. According to the 2010 version of the same EPA report, residential waste generation accounts for 55-65% of the total waste from the residential and commercial sectors;<sup>2</sup> for the per capita calculation, the median value of 60% of total waste generated is assumed. This number is multiplied by the amount of yard waste generated and divided by the U.S. population in 2014 (319 million people)<sup>3</sup> to determine the per capita amount of yard waste generated in the United States.

$$PC_{yw} = \frac{YW \times 0.60}{P_{y,US}} \quad (1)$$

Where:

- $PC_{yw}$  = Per capita value of yard waste in the US, in tons per person
- $YW$  = Annual yard waste generated, in million tons
- $P_{y,US}$  = Population of the US for year of inventory, in million people

The per capita value of yard waste is estimated to be 0.065 tons per person in 2014.

**Table 1. Annual Waste Generated in the US in 2014**

Material	Weight Generated (million tons)	Tons per person
Yard	34.50	0.065

Source: Reference 1, Table 1

As open burning is generally not practiced in urbanized areas, only the rural population in each county is assumed to practice open burning. The rural and urban populations are taken from 2010 U.S. Census data.<sup>4</sup> It is assumed that 24% of the rural population burns yard waste.<sup>5</sup>

$$PBurn_c = RPop_c \times 0.24 \quad (2)$$

Where:

$PBurn_c$  = Population likely to burn in county  $c$

$RPop_c$  = Rural population in county  $c$  in 2010

The number of people likely to burn waste in each county (from equation 2) is then used with the value of per capita yard waste generated (from equation 1) and two assumptions to determine the amount of leaf and brush waste burned. The first assumption concerns the composition of yard waste; of the total amount of yard waste generated, yard waste composition is assumed to be 25 percent leaves, 25 percent brush, and 50 percent grass by weight.<sup>6</sup> However, open burning of grass clippings is not typically practiced by homeowners, and as such only estimates for leaf burning and brush burning are developed.

The second assumption adjusts for variations in vegetation; the percentage of forested acres (including rural forest and urban forest) is determined using Version 2 of the Biogenic Emission Landuse Database (BELD2) within the Biogenic Emissions Inventory System (BEIS). Based on this percentage, county-level yard waste values are adjusted according to the values in Table 2. To better account for the native vegetation that likely occurs in residential yards of farming states, agricultural land acreage is subtracted before calculating the percentage of forested acres. All municipios in Puerto Rico and counties in the U.S. Virgin Islands, Hawaii, and Alaska were assumed to have greater than 50 percent forested acres.

$$LW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c} \quad (3)$$

$$BW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c} \quad (4)$$

Where:

$LW_c$  = Annual leaf waste burned in county  $c$ , in tons

$BW_c$  = Annual brush waste burned in county  $c$ , in tons

$PBurn_c$  = Population likely to burn in county  $c$ , from equation 2

$PC_{yw}$  = Per capita value of yard waste in the US, in tons per person, from equation 1

$YWFr_t$  = Fraction of total yard waste for waste type  $t$  (leaf or brush)

$AF_{fa,c}$  = Adjustment factor based on percent of forested acres in county  $c$ , from Table 2

**Table 2. Adjustment for Percentage of Forested Acres**

Percent Forested Acres per County	Adjustment for Yard Waste Generated
< 10%	0% generated
≥ 10% & < 50%	50% generated
≥ 50%	100% generated

## D. Allocation Procedure

National values for the amount of waste generated are distributed to the counties based on rural population, as described in Section C.

## E. Emissions Factors

Emissions factors for open burning of yard are reported in Table 4 and Table 5. The emissions factors for CAPs are from AP-42<sup>7</sup> and the emissions inventory improvement program.<sup>8</sup> For burning of leaves, emissions factors for PM<sub>25</sub> are calculated by multiplying the PM<sub>10</sub> emissions factor by a ratio of 0.7709. Emissions factors for HAPs are from an EPA Control Technology Center report.<sup>9</sup>

## F. Controls

Controls for residential yard waste burning are generally in the form of a ban on open burning of waste in a given municipality or county. However, literature suggests that burn bans are not 100% effective. It is therefore assumed that approximately 25% of the residents that may burn yard waste would burn do so even if a ban is in place. For counties that have burn bans, the assumption is applied by multiplying 0.25 by the annual waste burned. Currently no counties are assumed to have burn bans in place.

$$\begin{array}{l} \text{If county } c \text{ has a burn ban} \\ \text{Then } LW_c = LW_c \times 0.25 \end{array} \quad (5)$$

$$\begin{array}{l} \text{If county } c \text{ has a burn ban} \\ \text{Then } BW_c = BW_c \times 0.25 \end{array} \quad (6)$$

Where:

$$\begin{array}{ll} LW_c & = \text{Annual leaf waste burned in county } c, \text{ in tons} \\ BW_c & = \text{Annual brush waste burned in county } c, \text{ in tons} \end{array}$$

## G. Emissions

The annual amount of leaf and brush waste burned in each county is multiplied by the emissions factors listed in Table 4 and Table 5 to estimate emissions. Emissions for leaves and residential brush are calculated separately, since emission factors vary by yard waste type.

$$E_{p,c} = LW_c \times EF_p \quad (7)$$

$$E_{p,c} = BW_c \times EF_p \quad (8)$$

Where:

$$\begin{array}{ll} E_{p,c} & = \text{Annual emissions of pollutant } p \text{ in county } c \\ LW_c & = \text{Annual leaf waste burned in county } c, \text{ in tons} \\ BW_c & = \text{Annual brush waste burned in county } c, \text{ in tons} \\ EF_p & = \text{Emission factor for pollutant } p, \text{ in lbs. of pollution per ton of waste burned} \end{array}$$

## H. Point Source Subtraction

There are no point source-specific SCCs for open burning of yard waste; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 lists sample calculations to determine the CO emissions from open burning of yard waste in Autauga County, Alabama.

**Table 3. Sample calculations for CO emissions from open burning in Autauga County, AL**

Eq. #	Equation	Values for Autauga County, AL	Result
1	$PC_{yw} = \frac{YW \times 0.60}{P_{y,US}}$	$\frac{34.5 \text{ million tons} \times 0.60}{318.85 \text{ million people}}$	0.065 tons yard waste per person per year
2	$PBurn_c = RPop_c \times 0.24$	$22,921 \text{ people} \times 0.24$	5,501 people likely to burn in Autauga County, AL
3	$LW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c}$	$5,501 \text{ people} \times 0.065 \text{ tons} \times 0.25 \times 1$	89.39 tons of leaf waste burned in Autauga County, AL
4	$BW_c = PBurn_c \times PC_{yw} \times YWFr_t \times AF_{fa,c}$	$5,501 \text{ people} \times 0.065 \text{ tons} \times 0.25 \times 1$	89.39 tons of brush waste burned in Autauga County, AL
5	<i>If county c has a burn ban Then <math>LW_c = LW_c \times 0.25</math></i>	N/A	Autauga County, AL does not have a burn ban
6	<i>If county c has a burn ban Then <math>BW_c = BW_c \times 0.25</math></i>	N/A	Autauga County, AL does not have a burn ban
7	$E_{p,c} = LW_c \times EF_p$	$89.39 \text{ tons of leaf waste} \times 112 \text{ lbs. per ton}$	5.01 tons CO emissions from burning of leaf waste in Autauga County, AL
8	$E_{p,c} = BW_c \times EF_p$	$89.39 \text{ tons of brush waste} \times 140 \text{ lbs. per ton}$	6.26 tons CO emissions from burning of brush waste in Autauga County, AL

## J. Changes from 2014 Methodology

The 2017 emissions inventory methodology for yard waste burning includes a change to the method for determining population likely to burn. The 2014 v2 NEI methodology determined the population likely to burn by identifying the rural and “like rural” population in each county in 2010 and using the fraction of 2010 rural and like rural population to total population in order to determine the rural population in 2014. The 2017 methodology only uses the 2010 rural population to determine the population likely to burn.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data, since 2014 Census Data does not exist for the U.S. Virgin Islands.

## L. References

<sup>1</sup> U.S. Environmental Protection Agency. 2016. *Advancing Sustainable Materials: 2014 Fact Sheet*, "Table 1. Generation, Recovery and Discards of Materials in MSW, 2013(in millions of tons and percent of generation of each material)," <https://www.epa.gov/smm/advancing-sustainable-materials-management-facts-and->

[figures-report](#)

- <sup>2</sup> U.S. Environmental Protection Agency. 2011. *Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2010—Fact Sheet*," p. 4.  
[https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw\\_2010\\_factsheet.pdf](https://archive.epa.gov/epawaste/nonhaz/municipal/web/pdf/msw_2010_factsheet.pdf)
- <sup>3</sup> U.S. Census Bureau. *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2014 Populations Estimates*,  
[https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP\\_2016\\_PEPANNRES&src=pt](https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2016_PEPANNRES&src=pt)
- <sup>4</sup> U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1.  
[http://www2.census.gov/census\\_2010/04-Summary\\_File\\_1/](http://www2.census.gov/census_2010/04-Summary_File_1/).
- <sup>5</sup> Environment Canada. 2001. "Household Garbage Disposal and Burning." Prepared by Environics Research Group.
- <sup>6</sup> Two Rivers Regional Council of Public Officials and Patrick Engineering, Inc. 1994. "Emission Characteristics of Burn Barrels," prepared for the U.S. Environmental Protection Agency, Region V.
- <sup>7</sup> U.S. Environmental Protection Agency. 1992. AP-42, Fifth Edition, Volume 1, Chapter 2: Solid Waste Disposal. Section 2.5: Open Burning.
- <sup>8</sup> Eastern Research Group, Inc. Emissions Inventory Improvement Program. Volume III: Chapter 16, Open Burning. 2001. [https://www.epa.gov/sites/production/files/2015-08/documents/iii16\\_apr2001.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/iii16_apr2001.pdf)
- <sup>9</sup> U.S. Environmental Protection Agency, Control Technology Center. 1997. "Evaluation of Emissions from the Open Burning of Household Waste in Barrels." EPA-600/R-97-134a.  
[https://cfpub.epa.gov/si/si\\_public\\_record\\_Report.cfm?dirEntryID=115129](https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=115129)

**Table 4. Emissions Factors for Open Burning of Leaf Species**

<b>Pollutant</b>	<b>Pollutant Code</b>	<b>Emission Factor (original)</b>	<b>Emission Factor Units (original)</b>	<b>Emission Factor (converted)</b>	<b>Emission Factor Units (converted)</b>	<b>Reference &amp; Table No.</b>
CO	CO	112	lbs./ton	--	--	Reference 7, Table 2.5-6
Nitrogen Oxides	NOX	6.2	lbs./ton	--	--	Reference
PM10-FIL	PM10-FIL	38	lbs./ton	--	--	Reference 7, Table 2.5-6
PM10-PRI	PM10-PRI	38	lbs./ton	--	--	Reference 7, Table 2.5-6
PM25-FIL	PM25-FIL	29.3	lbs./ton	--	--	0.7709 * PM10
PM25-PRI	PM25-PRI	29.3	lbs./ton	--	--	0.7709 * PM10
Sulfur Dioxide	SO2	0.76	lbs./ton	--	--	Reference
VOC	VOC	28	lbs./ton	--	--	Reference 7, Table 2.5-6
Cumene	98828			0.01325	lbs./ton	Reference 9
Ethyl Benzene	100414			0.048	lbs./ton	Reference 9
Phenol	108952			0.115	lbs./ton	Reference 9
Styrene	100425			0.1015	lbs./ton	Reference 9

**Table 5. Emissions Factors for Open Burning of Brush Species**

<b>Pollutant</b>	<b>Pollutant Code</b>	<b>Emission Factor (original)</b>	<b>Emission Factor Units (original)</b>	<b>Emission Factor (converted)</b>	<b>Emission Factor Units (converted)</b>	<b>Reference &amp; Table No.</b>
CO	CO	140	lbs./ton	--	--	Reference 7, Table 2.5-5
Nitrogen Oxides	NOX	5	lbs./ton	--	--	Reference
PM10-PRI	PM10-PRI	17	lbs./ton	--	--	Reference 8
PM10-FIL	PM10-FIL	17	lbs./ton	--	--	Reference 8
PM25-PRI	PM25-PRI	13.1	lbs./ton	--	--	0.7709 * PM10
PM25-FIL	PM25-FIL	13.1	lbs./ton	--	--	0.7709 * PM10
Sulfur Dioxide	SO2	1.66	lbs./ton	--	--	Reference
VOC	VOC	19	lbs./ton	--	--	Reference 7, Table 2.5-5
Cumene	98828			0.01325	lbs./ton	Reference 9
Ethyl Benzene	100414			0.048	lbs./ton	Reference 9
Phenol	108952			0.115	lbs./ton	Reference 9
Styrene	100425			0.1015	lbs./ton	Reference 9

## CREMATION – HUMAN AND ANIMAL

### A. Source Category Description

The cremation of human remains results in emissions of particulate matter, SO<sub>2</sub>, NO<sub>x</sub>, VOC, CO, and HAPs. In particular, it is a significant source of mercury emissions, due to mercury in dental fillings, as well as mercury in blood and tissues. In 2014, human cremation resulted in the emissions of nearly two tons of mercury.

The cremation of animals also results in emissions of CAPs and HAPs, though it emits less mercury than human cremation. In 2014, animal cremation resulted in the emissions of 81 lbs. of mercury.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810060100	Miscellaneous Area Sources	Other Combustion	Cremation	Humans
2810060200	Miscellaneous Area Sources	Other Combustion	Cremation	Animals

### B. Overview of Calculations

The calculations for estimating emissions from human cremation involve estimating the number of deaths in each age group in each county, using data from the Centers for Disease Control and Prevention. The number of deaths is multiplied by the average weight by age group and the state-level cremation rate from the National Funeral Directors Association to estimate the total amount of cremations in each county in terms of mass. This number is multiplied by an emissions factor to estimate the emissions of CAPs and HAPs. Emissions of mercury include emissions from mercury in fillings in teeth and in blood and tissues. The emissions from mercury in fillings are estimated based on data on the number of filled teeth per person in each age group and assumptions about the proportion of fillings that contain mercury and the amount of mercury in each filling.

The calculations for estimating emissions from animal cremation involve determining the number of cremated animals nationally, and distributing this number to each county based on population. The number of cremated animals is multiplied by average weights for cats and dogs to determine the amount of cremations in each county in terms of mass. This number is multiplied by an emissions factor to estimate the emissions of CAPs and HAPs.

Sources of data and calculations for the number of human and animal cremations are discussed in section C. The process of allocating the number of animal cremations to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from human and animal cremation is discussed in section G.

### C. Activity Data

#### Human Cremation

The activity data for human cremation is based on the number of deaths in each county in 13 age groups, from the Centers for Disease Control and Prevention WONDER database.<sup>1</sup> Data for some counties are withheld in the WONDER database. These gaps are filled using the data on the total number of deaths by age group in each state (which includes the number of deaths that are withheld at the county level). First, the sum of the reported county-level number of deaths in each age group and state is subtracted from the reported state-level number of deaths in each age group to determine the total number of deaths withheld at the county level in each state and age group.

$$Deaths\_withheld_{s,a} = Deaths\_state_{s,a} - \sum Deaths\_county_{y,s,a} \quad (H1)$$

Where:

$Deaths\_withheld_{s,a}$  = Total number of withheld deaths in state  $s$  in age group  $a$   
 $Deaths\_state_{s,a}$  = Total number of deaths reported at the state level in state  $s$  in age group  $a$   
 $Deaths\_county_{s,a}$  = Total number of deaths reported at the county level in state  $s$  in age group  $a$

The total number of withheld deaths are distributed to the counties based on the proportion of population in those counties to the total state population.

$$Pop\_ratio_c = \frac{Pop_c}{Pop_s} \quad (H2)$$

Where:

$Pop\_ratio_c$  = The population ratio used to distribute withheld deaths in state  $s$  to county  $c$   
 $Pop_c$  = The total population of county  $c$   
 $Pop_s$  = The total population of state  $s$

The number of withheld deaths in each state is multiplied by the county population ratio to distribute the withheld deaths to the counties. Note that this step is only performed for counties where county-level data on number of deaths is withheld; this step is not performed where county-level data on deaths is reported.

$$Deaths_{c,a} = Deaths\_withheld_{s,a} \times Pop\_ratio_c \quad (H3)$$

Where:

$Deaths_{c,a}$  = The number of deaths in county  $c$  in age group  $a$   
 $Deaths\_withheld_{s,a}$  = Total number of withheld deaths in state  $s$  in age group  $a$ , from equation H1  
 $Pop\_ratio_c$  = The population ratio used to distribute withheld deaths in state  $s$  to county  $c$ , from equation H2

The total number of deaths in each county (either reported directly in the CDC WONDER database or estimated using equation H3) is multiplied by a state-level cremation rate, reported by the National Funeral Directors Association (NFDA),<sup>2</sup> shown in Table 1. It is assumed that the state-level cremation rate applies to all counties within the state.

$$Cremations_{c,a} = Deaths_{c,a} \times Cremation\_rate_s \quad (H4)$$

Where:

$Cremations_{c,a}$  = The number of human cremations in county  $c$  in age group  $a$   
 $Deaths_{c,a}$  = The number of deaths in county  $c$  in age group  $a$   
 $Cremation\_rate_s$  = The rate of human cremations in state  $s$ , from Table 1

**Table 1. Human cremation rate by state.** Error! Bookmark not defined.

State	Cremation Rate
Alabama	23.1%
Alaska	66.3%
Arizona	66.1%
Arkansas	32.7%
California	63.4%
Colorado	68.6%
Connecticut	50.3%

State	Cremation Rate
Delaware	46.2%
District of Columbia	40.0%
Florida	62.4%
Georgia	37.1%
Hawaii	72.7%
Idaho	56.8%
Illinois	42.8%

State	Cremation Rate
Indiana	36.6%
Iowa	42.2%
Kansas	44.6%
Kentucky	24.5%
Louisiana	26.3%
Maine	70.0%
Maryland	40.6%
Massachusetts	43.4%
Michigan	54.9%
Minnesota	57.2%
Mississippi	18.2%
Missouri	39.7%
Montana	72.8%
Nebraska	43.8%
Nevada	76.9%
New Hampshire	70.3%
New Jersey	40.6%
New Mexico	58.9%
New York	39.6%

State	Cremation Rate
North Carolina	39.8%
North Dakota	35.3%
Ohio	42.3%
Oklahoma	39.0%
Oregon	74.1%
Pennsylvania	43.1%
Rhode Island	46.6%
South Carolina	37.4%
South Dakota	35.4%
Tennessee	28.1%
Texas	39.3%
Utah	31.2%
Vermont	67.3%
Virginia	36.1%
Washington	75.5%
West Virginia	27.3%
Wisconsin	52.5%
Wyoming	66.7%

The CDC provides estimates of the average weight of individuals in each age group.<sup>3</sup> This number is multiplied by the number of cremations in each county in each age group and then summed across all age groups to estimate the total amount of cremations in tons in each county.

$$Cremations\_tons_c = \sum_{a=1}^A Cremations_{c,a} \times W_a \times \frac{1 \text{ ton}}{2,000 \text{ lbs}} \quad (H5)$$

Where:

$Cremations\_tons_c$  = The weight of humans cremated in county  $c$ , in tons  
 $Cremations_c$  = The number of human cremations in county  $c$ , from equation H4  
 $W_a$  = The average weight of individuals from age group  $a$

### **Animal Cremation**

The Pet Loss Professionals Alliance (PLPA) conducted a survey that estimated that there were 1,840,965 pet cremations in 2012, and that 99 percent of deceased pets are cremated.<sup>4</sup> In addition, the Humane Society of the United States estimates that there are 2,700,000 adoptable dogs and cats euthanized in animal shelters each year.<sup>5</sup> It is assumed that all of these shelter animals are cremated. Therefore, there are a total of approximately 4,540,965 animal creations each year. Note that this estimate does not double count the number of animal cremations, because the PLPA study counts the number of cremations of pets—i.e. animals that are owned by people—whereas the Humane Society estimates are for animals in shelters that were not adopted.

The population of cats and dogs is approximately 52.5 percent cats and 48.5 percent dogs.<sup>5</sup> Using this percentage and the total number of pets and shelter animals cremated annually, a total number of cats and a total number of

dogs cremated annually can be calculated.

$$Cremations_{c/d,US} = Ratio_{c/d} \times (Cremations_{pets,US} + Cremations_{shelter,US}) \quad (A1)$$

Where:

$Cremations_{c/d}$  = Total cats,  $c$ , or dogs,  $d$ , cremated annually in the United States  
 $Ratio_{c/d}$  = Ratio of cats,  $c$ , or dogs,  $d$ , in the pet population  
 $Cremations_{pets,US}$  = Total number of pets cremated annually in the United States  
 $Cremations_{shelter,US}$  = Total number of shelter animals cremated annually in the United States

The average weight of a domestic cat is approximately 4.5 kg (9.9 pounds).<sup>6</sup> The average weight of a dog is difficult to determine due to large differences in breeds, but an average across breeds is 48.5 pounds.<sup>7,\*</sup> To calculate the weight, in tons, of both cats and dogs cremated annually, the average weight values are multiplied by the total number of cats and total number of dogs cremated annually.

$$Cremations_{tons_{c/d}} = Cremations_{c/d} \times Weight_{c/d} \times \frac{1 \text{ ton}}{2,000 \text{ pounds}} \quad (A2)$$

Where:

$Cremations_{tons_{c/d,US}}$  = Total weight, in tons, of cats,  $c$ , or dogs,  $d$ , cremated annually in the United States  
 $Cremations_{c/d,US}$  = Total cats,  $c$ , or dogs,  $d$ , cremated annually in the United States  
 $Weight_{c/d}$  = Average weight per animal, in pounds, of cats,  $c$ , or dogs,  $d$

Once the weight of cats and weight of dogs cremated annually has been calculated, these values can be summed to derive a total weight of animals cremated annually. The total weight of cremated animals in 2014 was approximately 53,441 tons.

$$Cremations_{tons_{animal}} = Cremations_{tons_c} + Cremations_{tons_d} \quad (A3)$$

Where:

$Cremations_{tons_{animal,US}}$  = Total weight of animals cremated annually in the United States, in tons  
 $Cremations_{tons_c,US}$  = Total weight of cats,  $c$ , cremated annually in the United States, in tons  
 $Cremations_{tons_d,US}$  = Total weight of dogs,  $d$ , cremated annually in the United States, in tons

## D. Allocation Procedure

### Human Cremation

The number of deaths is reported by the CDC at the county level. Therefore, these data do not need to be allocated. For counties with withheld data on the number of deaths, the total number of withheld deaths is distributed to counties based on the proportion of population in those counties, as described in equations H1-H3.

### Animal Cremation

The estimated national-level total weight of animals cremated are allocated to the county level based on the ratio of population in each county to the total national population.

$$Cremations_{tons_{animal,c}} = Cremations_{tons_{animal,US}} \times \frac{Pop_c}{Pop_{US}} \quad (A4)$$

\* Note that this is a straight average of the average adult weight for male and female dogs across breeds. It is not a weighted average that takes into account the popularity of different breeds in the United States.

Where:

$Cremations\_tons_{animal,c}$  = Total weight of animals cremated in county  $c$ , in tons  
 $Cremations\_tons_{animal,US}$  = Total weight of animals cremated annually in the United States, in tons, from equation A3  
 $Pop_c$  = The total population of county  $c$   
 $Pop_{US}$  = The total population of the United States

## E. Emissions Factors

### Human and Animal Cremation – Blood and Tissues

The emissions factors for human and animal cremation for CAPs are from AP-42,<sup>8</sup> and a report by EPA on emissions tests of a crematory,<sup>9</sup> and are in units of pounds of emissions per ton cremated (Table 2). The emissions factors for most HAPs are a report from the California Air Resources Board,<sup>10</sup> as well as from the EPA emissions test of a crematory. The mercury emissions factor is from a review of multiple studies.<sup>11</sup> EPA uses the same emissions factors for emissions from cremation of blood and tissues for both humans and animals.

**Table 2. Emissions factors for emissions from the cremation of human and animal blood and tissues. Emissions factors in this table do not account for emissions of mercury from dental fillings.**

Pollutant	Pollutant Code	Emission Factor (lbs/ton)	Source
Carbon Monoxide	CO	2.947	8
Lead	7439921	0.009	9
Nitrogen Oxides	NOX	3.560	8
PM10 Primary	PM10-PRI	3.036	8 (65% of total PM)
PM2.5 Primary	PM25-PRI	2.022	8 (43.3% of total PM)
Sulfur Dioxide	SO2	2.173	8
Volatile Organic Compounds	VOC	0.299	8
Acenaphthene	83329	1.303E-06	10
Acenaphthylene	208968	8.971E-07	10
Acetaldehyde	75070	9.269E-04	10
Anthracene	120127	2.389E-06	10
Arsenic	7440382	5.097E-04	10
Benzo(a)anthracene	56553	1.166E-07	10
Benzo(a)pyrene	192972	4.720E-07	10
Benzo(b)fluoranthene	205992	1.737E-07	10
Benzo(g,h,i)perylene	191242	5.874E-07	10
Benzo(k)fluoranthene	207089	1.486E-07	10
Beryllium	7440417	1.760E-05	10
Cadmium	7440439	2.940E-03	9
Chromium (VI)	18540299	1.829E-04	10
Chrysene	218019	2.880E-07	10
Cobalt	7440484	8.869E-05	10
Dibenz(a,h)anthracene	53703	1.349E-07	10
Fluoranthene	206440	1.337E-06	10

Pollutant	Pollutant Code	Emission Factor (lbs/ton)	Source
Fluorene	86737	3.760E-06	10
Formaldehyde	50000	2.469E-04	10
Hydrogen Chloride	7647010	3.595E+00	9
Hydrogen Fluoride	7664393	8.651E-03	10
Indeno(1,2,3-cd)pyrene	193395	1.440E-07	10
Mercury	7439976	1.324E-04	11
Naphthalene	91203	7.520E-04	10
Nickel	7440020	4.149E-04	10
Phenanthrene	85018	1.531E-05	10
Pyrene	129000	1.474E-06	10
Selenium	7782492	4.971E-04	10

### **Human Cremation – Dental Mercury**

In addition to mercury emitted from the cremation of blood and tissues, mercury is also emitted due to the cremation of dental fillings. The Bay Area Air Quality Management District (BAAQMD) issued a report in 2012 estimating the average amount of mercury in teeth per person for ten age groups, based on data from CDC's National Health and Nutrition Examination Survey.<sup>12</sup> Table 3 shows the estimated amount of material in restored teeth by age group from the BAAQMD study, which is matched to the age groups used by the CDC Wonder database, which is the source of data on deaths by age group.

The BAAQMD memorandum is used to estimate that 31.6 percent of filled teeth in the 5-24 age groups contain amalgam. According to the American Dental Association (ADA 1998) more than 75 percent of restorations before the 1970s used dental amalgam, which declined to 50 percent by 1991. Using these numbers, it is assumed that 50 percent of the filled teeth for 25-44 age groups contain amalgam, 62.5 percent of filled teeth in the 45-64 age group, and 75 percent of filled teeth for people over 65. The Food and Drug Administration has discouraged the use of dental amalgam in children under 6.<sup>13</sup> While EPA does not have data on the percent of fillings containing dental amalgam for the 1-4 age group, it is assumed that this age group has approximately half the dental amalgam of the other age groups under 20 years old. The analysis also assumes that 45 percent of all amalgam-containing fillings are mercury, based on information from the Food and Drug Administration.<sup>13</sup>

**Table 3. Estimated amount of material in restored teeth.<sup>12</sup>**

Age Groups in CDC WONDER Database	Age Groups in BAAQMD Memorandum	Avg. Material in Restored Teeth (g)	% of Fillings Containing Mercury
< 1 year	0-4 years <sup>+</sup>	0.000	0.0%
1-4 years		0.160	15.8%
5-9 years	5-14 years	0.720	31.6%
10-14 years			
15-19 years	15-24 years	1.070	31.6%
20-24 years			
25-34 years	25-34 years	2.230	50.0%
35-44 years	35-44 years	3.290	50.0%
45-54 years	45-54 years	4.310	62.5%
55-64 years	55-64 years	4.320	62.5%
65-74 years	65-74 years	3.780	75.0%
75-84 years	75-84 years	3.650	75.0%

Age Groups in CDC WONDER Database	Age Groups in BAAQMD Memorandum	Avg. Material in Restored Teeth (g)	% of Fillings Containing Mercury
85+ years	85+ years	2.960	75.0%

<sup>+</sup> It is assumed that children under the age of 1 have no dental mercury.

The emissions factor for mercury in teeth is calculated by multiplying the average amount of material in restored teeth per person by the percentage of fillings containing mercury in each age group and the proportion of mercury in dental amalgam (approximately 45 percent).

$$EF_{teeth_{Hg,a}} = Material_a \times ContainHg_a \times HgProportion \times 0.0022 \frac{lb}{g} \quad (H6)$$

Where:

- $EF_{teeth_{Hg,a}}$  = Emission factor for mercury emissions from teeth due to cremation for age group  $a$ , in lbs. per cremation
- $Material_a$  = The average amount of material in restored teeth for age group  $a$ , in grams, from Table 2
- $ContainHg_a$  = The proportion of people in age group  $a$  with fillings that contain mercury, from Table 2
- $HgProportion$  = The proportion of dental amalgam that is mercury (approximately 45 percent)

## F. Controls

There are no controls assumed for this source category.

## G. Emissions

### Human Cremation

To estimate the emissions of CAPs from human cremation, the total number of human cremations in each county, in tons, is multiplied by the emissions factor for each pollutant, from Table 2.

$$Emissions_{p,c} = Cremation_{tons_c} \times EF_p \quad (H7)$$

Where:

- $Emissions_{p,c}$  = Emissions of pollutant  $p$  from human cremation in county  $c$ , in pounds
- $Cremations_{tons_c}$  = The number of human cremations in county  $c$ , in tons
- $EF_p$  = Emissions factor for pollutant  $p$  from human cremation, in lbs. per ton

The emissions from mercury in teeth are estimated based on the number of cremations rather than the weight. To estimate the emissions of mercury from teeth during human cremation, the number of cremations in each age group is multiplied by the emissions factor for each age group and then summed across age groups.

$$Emissions_{teeth_{Hg,c}} = \sum_{a=1}^A Cremations_{c,a} \times EF_{teeth_{Hg,a}} \quad (H8)$$

Where:

- $Emissions_{teeth_{Hg,c}}$  = Emissions of mercury in teeth from human cremation in county  $c$ , in pounds
- $Cremations_{c,a}$  = The number of human cremations in county  $c$  in age group  $a$
- $EF_{teeth_{Hg,a}}$  = Emissions factor for mercury emissions from teeth due to cremation for age group  $a$ ,

in lbs. per cremation

The emissions from mercury from blood and tissues are estimated by multiplying the total number of cremations in each county, in tons, by the emissions factor for mercury from blood and tissues.

$$Emissions\_tissue_{Hg,c} = Cremations\_tons_c \times EF\_tissue_{Hg} \quad (H9)$$

Where:

$Emissions\_tissue_{Hg,c}$  = Emissions of mercury in tissues from human cremation in county  $c$ , in pounds  
 $Cremations\_tons_c$  = The number of human cremations in county  $c$ , in tons  
 $EF\_tissue_{Hg,a}$  = Emissions factor for mercury emissions from blood and tissues due to cremation for  
in lbs. per ton

The total emissions of mercury from cremation in each county is calculated by adding the emissions of mercury from teeth and the emissions of mercury from tissues.

$$Emissions_{Hg,c} = Emissions\_teeth_{Hg,c} + Emissions\_tissue_{Hg,c} \quad (H10)$$

Where:

$Emissions_{Hg,c}$  = Emissions of mercury from human cremation in county  $c$ , in pounds  
 $Emissions\_teeth_{Hg,c}$  = Emissions of mercury in teeth from human cremation in county  $c$ , in pounds  
 $Emissions\_tissue_{Hg,c}$  = Emissions of mercury in tissues from human cremation in county  $c$ , in pounds

### **Animal Cremation**

$$Emissions_{p,c} = Cremation\_tons_c \times EF_p \quad (A5)$$

Where:

$Emissions_{p,c}$  = Emissions of pollutant  $p$  from animal cremation in county  $c$ , in pounds  
 $Cremations\_tons_c$  = The number of animal cremations in county  $c$ , in tons  
 $EF_p$  = Emissions factor for pollutant  $p$  from animal cremation, in lbs. per ton

## **H. Point Source Subtraction**

There are no point source-specific SCCs for crematoria; therefore point source subtraction is not performed for this category.

## **I. Sample Calculations**

The following table lists the sample calculations for estimating mercury emissions from human cremation in the 85+ age group and animal cremation of cats in Clark County, ID. To estimate the total emissions in Clark County, these steps would be repeated to estimate emissions from all age groups and from cremation of dogs.

**Table 4. Sample calculations for mercury emissions from human cremation for the 85+ age group and cremation of cats in Clark County, ID.**

Eq. #	Equation	Values for Clark County, ID	Result
H1	$Deaths_{withheld_{s,a}}$ $= Deaths_{state_{s,a}}$ $- \sum Deaths_{county_{s,a}}$	<p>4,013 state level deaths</p> <p>– 3,997 total county level deaths</p>	16 withheld deaths in Idaho
H2	$Pop_{ratio_c} = \frac{Pop_c}{Pop_s}$	<p>873 people in Clark County</p> <p>1,975 total population of counties with withheld deaths</p>	0.442 population ratio
H3	$Deaths_{c,a}$ $= Deaths_{withheld_{s,a}}$ $\times Pop_{ratio_c}$	16 withheld deaths × 0.442 population ratio	7 deaths in Clark County, ID
H4	$Cremations_{c,a}$ $= Deaths_{c,a}$ $\times Cremation_{rate_s}$	7 deaths × 56.8% cremation rate	4 cremations in Clark County, ID
H5	$Cremations_{tons_c}$ $= \sum_{a=1}^A Cremations_{c,a} \times W_a$ $\times \frac{1 \text{ ton}}{2,000 \text{ lbs}}$	<p>4 cremations × 158.25 lbs per person in 85+ age group ÷ 2000 lbs per ton</p>	0.3165 tons cremations in Clark County, ID
H6	$EF_{teeth_{Hg,a}}$ $= Material_a \times ContainHg_a$ $\times HgProportion$ $\times 0.0022 \frac{lb}{g}$	<p>2.96 g mercury × 75 % with mercury × 45% of fillings are mercury × 0.0022</p>	0.0022 lbs. mercury per cremation
H7	$Emissions_{p,c}$ $= Cremation_{tons_c} \times EF_p$	N/A	Completed in equation H9 for mercury
H8	$Emission_{teeth_{Hg,c}}$ $= \sum_{a=1}^A Cremations_{c,a}$ $\times EF_{teeth_{Hg,a}}$	4 cremations × 0.0022 lbs per cremation	0.0088 lbs. mercury from teeth in 85+ age group in Clark County, ID
H9	$Emissions_{tissue_{Hg,c}}$ $= Cremations_{tons_c}$ $\times EF_{tissue_{Hg}}$	0.3165 tons cremations × 0.0015 lbs per ton	0.00047 lbs. mercury from tissues in 85+ age group in Clark County, ID

Eq. #	Equation	Values for Clark County, ID	Result
H10	$Emissions_{Hg,c}$ $= Emissions_{teeth_{Hg,c}}$ $+ Emissions_{tissue_{Hg,c}}$	0.0088 lbs from teeth + 0.00047 lbs. from tissues	0.0093 lbs. mercury from cremation of 85+ age group in Clark County ID
A1	$Cremations_{c/d,US}$ $= Ratio_{c/d}$ $\times (Cremations_{pets_{US}}$ $+ Cremations_{shelter_{US}})$	52.5% of cats in pet population × (1,840,965 pet cremations + 2,700,000 shelter animal cremations)	2,384,006 cremated cats in the U.S.
A2	$Cremations_{tons_c}$ $= Cremations_c \times Weight_c$ $\times \frac{1 \text{ ton}}{2,000 \text{ pounds}}$	2,384,006 cremated cats × 9.9 lbs per cat ÷ 2000 lbs per ton	11,800 tons of cremated cats in the U.S.
A3	$Cremations_{tons_{animal}}$ $= Cremations_{tons_c}$ $+ Cremations_{tons_d}$	N/A	Cremations of dogs are not estimated in this sample calculation
A4	$Cremations_{tons_{animal,c}}$ $= Cremations_{tons_{animal,US}}$ $\times \frac{Pop_c}{Pop_{US}}$	11,800 cremated cats × $\frac{873 \text{ people in Clark}}{329,164,967 \text{ people in US}}$	0.03 tons cats cremated in Clark County, ID
A5	$Emissions_{p,c}$ $= Cremation_{tons_c} \times EF_p$	0.03 × 0.0015 lbs per ton	0.000045 lbs. mercury emissions from cremation of cats in Clark County, ID

## J. Changes from 2014 Methodology

There is one slight change from the 2014 methodology for the estimation of emissions from human cremation. In the 2014 methodology, the emissions factor for mercury emissions from cremation of blood and tissues was in units of per cremation. In the 2017 methodology, EPA uses the same emissions factor, but converted it to a per-ton emissions factor. The per-ton emissions factor is multiplied by the number of tons cremated in each county.

The most significant difference from the 2014 methodology for the estimation of emissions from animal cremation is that EPA now estimates emissions of pollutants other than mercury. In the 2017 methodology, EPA uses the emissions factors for cremation of human blood and tissues to estimate emissions from animals.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions from human cremation for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

Emissions from animal cremation are based on county population; therefore the emissions from animal cremation in Puerto Rico and the Virgin Islands are calculated using the method described for the rest of the counties.

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## DUST KICKED UP BY ANIMALS

### A. Source Category Description

Dust kicked up by animals refers to the dust emitted from different types of livestock feet. These emissions are primarily considered to be made by cattle and swine, but poultry emissions of dust are also examined. Fugitive dust emissions from animals are estimated for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. In 2014, dust from animals in the US, Puerto Rico, and US Virgin Islands resulted in 1,078,49.73 tons of PM10-PRI and 204,225.20 tons of PM25-PRI emissions.

For this source category, the following SCCs were assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2805001000	Miscellaneous Area Sources	Agriculture Production – Livestock	Beef cattle - finishing operations on feedlots (drylots)	Dust Kicked-up by Hooves
2805001010	Miscellaneous Area Sources	Agriculture Production – Livestock	Dairy Cattle	Dust Kicked-up by Hooves
2805001020	Miscellaneous Area Sources	Agriculture Production – Livestock	Broilers	Dust Kicked-up by Feet
2805001030	Miscellaneous Area Sources	Agriculture Production – Livestock	Layers	Dust Kicked-up by Feet
2805001040	Miscellaneous Area Sources	Agriculture Production – Livestock	Swine	Dust Kicked-up by Hooves
2805001050	Miscellaneous Area Sources	Agriculture Production – Livestock	Turkeys	Dust Kicked-up by Feet

### B. Overview of Calculations

The calculations for estimating the emissions from dust kicked up by animals involves multiplying the livestock counts by an emission factor for PM10-PRI, PM10-FIL, PM25-PRI, and PM25-FIL. Sources of data and calculations for the livestock counts are discussed in section C. The process of allocating activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from dust from animals is discussed in section G.

### C. Activity Data

The activity data for this source category is based on livestock counts (average annual number of standing head) and population information by state and county used to develop U.S. EPA's Greenhouse Gas Inventory.<sup>1</sup> This data set is derived from multiple data sets from the United States Department of Agriculture (USDA), particularly the National Agricultural Statistics Service (NASS) survey and census.<sup>2</sup> The USDA NASS survey dataset, which represents latest available, 2017 national livestock data, is used to obtain the livestock counts for as many counties as possible across the United States. For a full description of the GHG livestock population estimation methodology, refer to the above referenced citation for the EPA's GHG inventory document.

Generally, counties not specifically included in the NASS survey data set (e.g., due to business confidentiality reasons) were gap-filled based on the difference in the reported state total animal counts and the sum of all county-level reported animal counts. State-level data on animal counts from the GHG inventory were distributed to counties based on the proportion of animal counts in those counties from the 2012 NASS census.

$$P_{a,c,2017} = P_{a,s,2017} \times r_{a,c,2012} \quad (1)$$

Where:

- $P_{a,c,2017}$  = Estimated population of animal type  $a$  in county  $c$   
 $P_{a,s,2017}$  = NASS survey reported state-level population of animal type  $a$  in state  $s$   
 $r_{a,c,2012}$  = Ratio of animal county- to state-level animal counts from the 2012 NASS census for animals type  $a$  in county  $c$

#### D. Allocation Procedure

The USDA survey reports the livestock counts at the county level for many counties, so no allocation is necessary. The procedure for gap-filling missing county-level data using state-level data is described in section C.

#### E. Emissions Factors

Emission factors for dust from animals are reported in Table 1. Dust emission factors are from different literature articles for each livestock type. No references for PM25 emission factors were found in the literature for Beef Cattle. To calculate PM25 for Beef Cattle, the Dairy Cattle PM10 to PM25 ratio of 4.81 from this tool was used and is based on ratios in the PM Augmentation tool.<sup>3</sup> In general, if the study calculated an emission factor, it was converted to units of ton/year/head and is used in this tool. If the study did not calculate an emission factor, then it was calculated by dividing the emission rate in tons per year by animal units according to an equation used by the NRC's Scientific Basis for Estimating Air Emissions from Animal Feeding Operations: Interim Report<sup>4</sup>. Animal units are calculated by multiplying an equivalent factor by the livestock population according to an equation from the Wisconsin Department of Natural Resources.<sup>5</sup> Equivalent factors are listed in Table 2. After converting the AU to number of animals, assuming that 1 AU is equivalent to 500 kilograms, the emission factor is calculated in units of tons per year per head.

**Table 1. Emissions Factors for Dust Kicked-up by Animals**

Animal Type	Pollutant	EF (ton/year/1000head)	EF (ton/year/head)	References
Dairy Cattle	PM10-PRI	3.86685175	0.003866852	Ref 5; Ref 6; Ref 7; Ref 8
Dairy Cattle	PM10-FIL	3.86685175	0.003866852	Ref 5; Ref 6; Ref 7; Ref 8
Dairy Cattle	PM25-PRI	0.803721667	0.000803722	Ref 5; Ref 6; Ref 8
Dairy Cattle	PM25-FIL	0.803721667	0.000803722	Ref 5; Ref 6; Ref 8
Beef Cattle	PM10-PRI	11.46679018	0.01146679	Ref 10
Beef Cattle	PM10-FIL	11.46679018	0.01146679	Ref 10
Beef Cattle	PM25-PRI	0.803722	0.000803722	Beef cattle EF adjusted by PM10 to PM25 ratio of 4.81
Beef Cattle	PM25-FIL	0.803722	0.000803722	Beef cattle EF adjusted by PM10 to PM25 ratio of 4.81
Swine	PM10-PRI	0.803607373	0.000803607	Ref 11; Ref 8
Swine	PM10-FIL	0.803607373	0.000803607	Ref 11; Ref 8
Swine	PM25-PRI	0.008562274	8.56227E-06	Ref 8
Swine	PM25-FIL	0.008562274	8.56227E-06	Ref 8
Laying Hens	PM10-PRI	0.027138046	2.7138E-05	Ref 12; Ref 13; Ref 14; Ref 15; Ref 16; Ref 17; Ref 8; Ref 18
Laying Hens	PM10-FIL	0.027138046	2.7138E-05	Ref 12; Ref 13; Ref 14; Ref 15; Ref 16; Ref 17; Ref 8; Ref 18
Laying Hens	PM25-PRI	0.003368297	3.3683E-06	Ref 14; Ref 15; Ref 16; Ref 17; Ref 8; Ref 18
Laying Hens	PM25-FIL	0.003368297	3.3683E-06	Ref 14; Ref 15; Ref 16; Ref 17; Ref 8; Ref 18
Broiler	PM10-PRI	0.023119233	2.31192E-05	Ref 20; Ref 21; Ref 22; Ref 23; Ref 18; Ref 8
Broiler	PM10-FIL	0.023119233	2.31192E-05	Ref 20; Ref 21; Ref 22; Ref 23; Ref 18; Ref 8
Broiler	PM25-PRI	0.002004275	2.00427E-06	Ref 20; Ref 22; Ref 23; Ref 18; Ref 8
Broiler	PM25-FIL	0.002004275	2.00427E-06	Ref 20; Ref 22; Ref 23; Ref 18; Ref 8

Animal Type	Pollutant	EF (ton/year/1000head)	EF (ton/year/head)	References
Turkey	PM10-PRI	0.32615159	0.000326152	Ref 24; Ref 7; Ref 8
Turkey	PM10-FIL	0.32615159	0.000326152	Ref 24; Ref 7; Ref 8
Turkey	PM25-PRI	0.02623985	2.62399E-05	Ref 24; Ref 8
Turkey	PM25-FIL	0.02623985	2.62399E-05	Ref 24; Ref 8

**Table 2. AU Equivalent Factors for each Animal Type**

Animal Type	Specification	AU Equivalent Factor
Cattle	Dairy/Beef Calves (under 400 lbs)	0.20
Dairy Cattle	Milking & Dry Cows	1.40
Dairy Cattle	Heifers (800-1200 lbs)	1.10
Dairy Cattle	Heifers (400-800 lbs)	0.60
Beef Cattle	Steers or Cows (400 lbs to market)	1.00
Beef Cattle	Bulls	1.40
Cattle	Veal Calves	0.50
Swine	Pigs (up to 55 lbs)	0.10
Swine	Pigs (55 lbs to market)	0.40
Swine	Sows	0.40
Swine	Boars	0.50
Chicken	Layers – non-liquid manure system	0.01
Chicken	Broilers/pullets – non-liquid manure system	0.005
Chicken	Bird – liquid manure system	0.033
Ducks	Liquid manure system	0.2
Ducks	Non-liquid manure system	0.01
Turkeys	Turkey	0.018
Sheep	Sheep	0.1
Horses	Horses	2

## F. Controls

There are no controls assumed for this category.

## G. Emissions

For each animal type and pollutant the livestock count is multiplied by the emissions factors in Table 1 to estimate emissions.

$$E_{p,c,a} = P_{a,c} \times EF_{p,a} \quad (2)$$

Where:

- $E_{p,c,a}$  = Annual emissions of pollutant  $p$  in county  $c$  for animal type  $a$ , in tons per year
- $P_{a,c}$  = Population of livestock for animal type  $a$  in county  $c$
- $EF_{p,a}$  = Emissions factor for pollutant  $p$  and animal type  $a$ , in tons per year per head

## H. Point Source Subtraction

There are no point source-specific SCCs for composting; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 lists sample calculations to determine PM<sub>10</sub>-PRI emissions from dust kicked up by animals in Apache County, Arizona. The sample calculations use swine as an example, but the calculations would need to be repeated to calculate values for all livestock types.

**Table 3. Sample calculations for PM<sub>10</sub>-PRI emissions from dust kicked up by animals in Apache County, AZ.**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$P_{a,c,2017} = P_{a,s,2017} \times r_{a,c,2012}$	N/A	2017 swine population is available by county and does not need to be calculated using 2012 NASS Census ratios.
2	$E_{p,c,a} = P_{a,c} \times EF_{p,a}$	5,813 <i>swine in Apache</i> $\times 0.000803607$ <i>tons PM<sub>10</sub> per head of swine</i>	4.67 tons PM <sub>10</sub> -PRI emissions from swine in Apache County, AZ

## J. Changes from 2014 Methodology

When calculating livestock populations, heifers and calves are now included in population totals for dairy cattle in addition to mature dairy cows. For poultry-layers, pullets (young hens) are now included in population totals.

In addition, in the 2014 methodology, emissions were summed across all animal types and reported as a single SCC. In 2017, emissions are reported in separate SCCs for each individual animal type.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above

## L. References

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## INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL FUEL CONSUMPTION

### A. Source Category Description

Industrial, Commercial, and Institutional (ICI) fuel consumption includes emissions from boilers, engines, and other combustion sources from the industrial, commercial, and institutional sectors that are not reported as point sources. This source category includes emissions from combustion of coal, distillate fuel oil, residual fuel oil, kerosene, liquefied petroleum gas (LPG), natural gas, and wood. In 2014, ICI emissions in the US, Puerto Rico, and US Virgin Islands resulted in approximately 160,000 tons of PM<sub>2.5</sub>-PRI emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2102001000	Stationary Source Fuel Combustion	Industrial	Anthracite Coal	Total: All Boiler Types
2102002000	Stationary Source Fuel Combustion	Industrial	Bituminous/Subbituminous Coal	Total: All Boiler Types
2102004001	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All Boiler Types
2102004002	Stationary Source Fuel Combustion	Industrial	Distillate Oil	All IC Engine Types
2102005000	Stationary Source Fuel Combustion	Industrial	Residual Oil	Total: All Boiler Types
2102006000	Stationary Source Fuel Combustion	Industrial	Natural Gas	Total: Boilers and IC Engines
2102007000	Stationary Source Fuel Combustion	Industrial	Liquefied Petroleum Gas (LPG)	Total: All Boiler Types
2102008000	Stationary Source Fuel Combustion	Industrial	Wood	Total: All Boiler Types
2102011000	Stationary Source Fuel Combustion	Industrial	Kerosene	Total: All Boiler Types
2103001000	Stationary Source Fuel Combustion	Commercial/Institutional	Anthracite Coal	Total: All Boiler Types
2103002000	Stationary Source Fuel Combustion	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types
2103004001	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	Boilers
2103004002	Stationary Source Fuel Combustion	Commercial/Institutional	Distillate Oil	IC Engines
2103005000	Stationary Source Fuel Combustion	Commercial/Institutional	Residual Oil	Total: All Boiler Types
2103006000	Stationary Source Fuel Combustion	Commercial/Institutional	Natural Gas	Total: Boilers and IC Engines
2103007000	Stationary Source Fuel Combustion	Commercial/Institutional	Liquefied Petroleum Gas (LPG)	Total: All Combustor Types
2103008000	Stationary Source Fuel Combustion	Commercial/Institutional	Wood	Total: All Boiler Types
2103011000	Stationary Source Fuel Combustion	Commercial/Institutional	Kerosene	Total: All Combustor Types

### B. Overview of Calculations

The calculations for estimating emissions from the ICI sectors include estimating the total fuel consumption by sector in each state, using data from the Energy Information Administration (EIA) State Energy Data System (SEDS).<sup>1</sup> Total fuel consumption is adjusted to account for fuel consumed by mobile sources in each sector and fuel

used as an input to industrial processes but is not combusted. Fuel consumption from nonpoint sources in each state is determined by subtracting fuel consumption from point sources from total fuel consumption. Estimated nonpoint source fuel consumption in each state is distributed to the county level based on the proportion of employment in the industrial and commercial sectors.

Sources of data and adjustment calculations for fuel consumption are discussed in section C. The process of allocating activity data to the county level is discussed in section O. Emissions factors are discussed in section E. The estimation of emissions from ICI fuel consumption is discussed in section G. The process of subtracting point source data is discussed in section H.

### C. Activity Data

The activity data for this source category is total fuel consumption in the industrial and commercial/institutional sectors. The default data for this category are obtained from the total 2017 state-level fuel consumption in each sector from EIA SEDS<sup>1</sup> for all fuel types except distillate. Distillate fuel consumption is taken from EIA's Form 821 data, which reports distillate sales by state and sector for 2016.<sup>2</sup> State, local, and tribal (SLT) agencies are expected to submit state-level fuel consumption data from point sources in these sectors. The state-level point source fuel consumption is subtracted from the total fuel consumption to estimate the fuel consumption from nonpoint sources. The point source subtraction method is described in more detail in section H.

Total fuel consumption is adjusted to account for the fraction of fuel consumed by nonroad mobile sources, whose emissions are included in the nonroad inventory. This fraction is based on results from the National Mobile Inventory Model (NMIM), a precursor to EPA's Motor Vehicle Emission Simulator (MOVES). This adjustment is particularly important for distillate fuel oil consumption. The ICI tool uses distillate consumption data from Form 821 rather than SEDS because Form 821 reports more detailed data by sector, and the ICI tool uses different stationary source fuel consumption assumptions by sector, including the industrial, commercial, farm, off-highway, and oil company sectors. Note that fuel consumption in the farm, off-highway, and oil company sectors are mapped to the industrial sector in the ICI tool. Assumptions about the fraction of fuel consumed by stationary sources are shown in an appendix.

The total fuel consumption is also adjusted to account for fuel used as an input to industrial processes where it is not combusted. These assumptions are based on the EIA Manufacturing Energy Consumption Survey (MECS),<sup>3</sup> which reports both total fuel consumption and non-combustion use of fuel by Census region. Assumptions about non-combustion use of fuel are shown in Table 1. In some cases EIA withholds the regional-level data on non-combustion use of fuel because it is less than 0.5 million barrels. In these cases, a value of 0.25 million barrels is used as the amount of regional-level non-combustion use of fuels.

Note that the stationary source adjustment is performed for fuel consumption from both the industrial and commercial/institutional sectors, while the non-combustion use of fuel adjustment is performed only for fuel consumption in the industrial sector.

$$AF_{f,s,x} = TF_{f,s,x} \times SS_{f,s,x} \times (1 - nc_{f,s,industrial}) \quad (1)$$

Where:

- $AF_{f,s,x}$  = Consumption of fuel  $f$  by stationary sources in state  $s$  in sector  $x$
- $TF_{f,s,x}$  = Total consumption of fuel  $f$  in state  $s$  in sector  $x$ , from EIA SEDS
- $SS_{f,s,x}$  = Fraction of fuel  $f$  consumed by stationary sources in state  $s$  in sector  $x$
- $nc_{f,s,x}$  = Fraction of fuel  $f$  used as an industrial input and is not combusted in state  $s$  in the industrial sector, from Table 1

**Table 1. Assumptions about non-combustion use of fuel by fuel type and state.**

State	Coal	Distillate	LPG	Natural Gas	Residual Oil	Kerosene
AK	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
AL	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%

State	Coal	Distillate	LPG	Natural Gas	Residual Oil	Kerosene
AR	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
AZ	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
CA	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
CO	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
CT	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
DC	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
DE	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
FL	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
GA	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
HI	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
IA	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
ID	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
IL	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
IN	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
KS	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
KY	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
LA	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
MA	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
MD	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
ME	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
MI	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
MN	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
MO	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
MS	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
MT	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
NC	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
ND	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
NE	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
NH	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
NJ	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
NM	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
NV	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
NY	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
OH	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
OK	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
OR	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
PA	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
RI	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
SC	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
SD	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%

State	Coal	Distillate	LPG	Natural Gas	Residual Oil	Kerosene
TN	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
TX	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
UT	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
VA	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
VT	75.0%	8.3%	91.3%	1.0%	0.0%	0.0%
WA	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%
WI	44.0%	6.3%	80.0%	4.3%	100.0%	0.0%
WV	29.4%	11.1%	98.9%	13.3%	81.8%	0.0%
WY	0.0%	8.3%	6.3%	1.6%	0.0%	0.0%

The SEDS data do not distinguish between anthracite and bituminous/subbituminous coal consumption estimates. The EIA table “Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin and Method of Transportation”<sup>4</sup> provides state-level coal distribution data for 2006 that is used to estimate the fraction of coal consumption that is anthracite and bituminous/subbituminous. Table 2 presents the anthracite and bituminous coal ratios for each state.

**Table 2. Anthracite and Bituminous Coal Distribution for the Residential and Commercial Sectors**

State	Ratio of Bituminous	Ratio of Anthracite	State	Ratio of Bituminous	Ratio of Anthracite
Alabama	1.000	0.000	Montana	1.000	0.000
Alaska	1.000	0.000	Nebraska	1.000	0.000
Arizona	0.814	0.186	Nevada	1.000	0.000
Arkansas	0.814	0.186	New Hampshire	0.000	1.000
California	1.000	0.000	New Jersey	0.000	1.000
Colorado	0.996	0.004	New Mexico	1.000	0.000
Connecticut	0.000	1.000	New York	0.600	0.400
Delaware	0.814	0.186	North Carolina	1.000	0.000
Dist. Columbia	1.000	0.000	North Dakota	1.000	0.000
Florida	0.814	0.186	Ohio	0.873	0.127
Georgia	1.000	0.000	Oklahoma	0.917	0.083
Hawaii	1.000	0.000	Oregon	1.000	0.000
Idaho	0.979	0.021	Pennsylvania	0.194	0.806
Illinois	0.998	0.002	Rhode Island	0.000	1.000
Indiana	0.947	0.053	South Carolina	0.997	0.003
Iowa	0.999	0.001	South Dakota	1.000	0.000
Kansas	1.000	0.000	Tennessee	0.994	0.006
Kentucky	0.998	0.002	Texas	0.814	0.186
Louisiana	1.000	0.000	Utah	1.000	0.000
Maine	0.000	1.000	Vermont	0.000	1.000
Maryland	0.929	0.071	Virginia	0.963	0.037
Massachusetts	0.500	0.500	Washington	1.000	0.000
Michigan	0.667	0.333	West Virginia	0.905	0.095
Minnesota	0.997	0.003	Wisconsin	0.991	0.009
Mississippi	1.000	0.000	Wyoming	1.000	0.000
Missouri	1.000	0.000			

Source: Reference 4

The SEDS data on industrial and commercial coal consumption are split into consumption of anthracite and bituminous/subbituminous coal based on the ratios in Table 2.

$$AF_{ant/bit,s,x} = AF_{coal,s,x} \times R_{ant/bit,s} \quad (2)$$

Where:

$AF_{ant/bit,s,x}$	=	Adjusted anthracite or bituminous coal consumption in state $s$ in sector $x$
$AF_{coal,s,x}$	=	Total adjusted coal consumption in state $s$ in sector $x$ , from equation 1
$R_{ant/bit,s}$	=	Ratio of anthracite or bituminous coal to total coal in state $s$ , from Table 2

The EIA Form 821 data report total distillate consumption, but the NEI requires data separately on consumption by boilers and engines, because there are substantially different emissions factors for distillate boilers and engines. The ICI tool uses assumptions based on the EIA MECS<sup>3</sup> and the EIA Commercial Building Energy Consumption Survey (CBECS).<sup>5</sup> These data sources suggest that in the industrial sector, 60 percent of distillate consumption is by boilers and 40 percent by engines, and in the commercial sector, 95 percent is by boilers and 5 percent is by engines.

$$AF_{boiler/engine,s,x} = AF_{distillate,s,x} \times R_{boiler/engine,s,x} \quad (3)$$

Where:

$AF_{boiler/engine,s,x}$	=	Adjusted distillate consumption in boilers or engines state $s$ in sector $x$
$AF_{distillate,s,x}$	=	Total adjusted distillate consumption in state $s$ in sector $x$ , from equation 1
$R_{boiler/engine,s,x}$	=	Ratio of distillate consumption by boilers or engines in state $s$ in sector $x$

Following the adjustments to the total fuel consumption, the total fuel consumption data is also adjusted to subtract fuel consumption from point sources, which is accounted for in the point source inventory. Point source fuel consumption data by fuel type and sector is submitted by SLT agencies. This point source subtraction procedure is described in more detail in section H. The point source subtraction step is performed at the state level, and it is done before the allocation procedure discussed in section D and before the emissions calculations discussed in section G.

## D. Allocation Procedure

SEDS data are reported at the state level. Following the adjustments to the state level fuel consumption discussed in section C and the point source subtraction discussed below in section H, the estimated state-level nonpoint source activity data in each state is distributed to the county level based on employment in the industrial or commercial sector from the Census Bureau's County Business Patterns.<sup>6</sup> The adjusted nonpoint fuel consumption in each state is distributed to the county based on the proportion of employment in each county in each sector to the total employment at the state level in each sector.

$$NPF_{f,c,x} = NPF_{f,s,x} \times \frac{emp_{c,x}}{emp_{s,x}} \quad (4)$$

Where:

$NPF_{f,c,x}$	=	Adjusted nonpoint consumption of fuel $f$ in county $c$ in sector $x$
$NPF_{f,s,x}$	=	Adjusted nonpoint consumption of fuel $f$ in state $s$ in sector $x$ , from equation 6
$emp_{c,x}$	=	Employment in county $c$ in sector $x$
$emp_{s,x}$	=	Employment in state $s$ in sector $x$

Employment in each sector is determined based on the crosswalk between North American Industrial Classification System (NAICS) codes and sectors, as shown in Table 6 in the appendix.

## E. Emissions Factors

The emissions factors for ICI sectors are from AP-42<sup>7</sup> and a spreadsheet developed in 2010 by EPA and the Eastern Regional Technical Advisory Committee.<sup>8</sup> The emissions factors for ammonia are taken from one of two reports from EPA on ammonia emissions in the ICI sectors.<sup>9,10</sup> The emissions factors for hazardous air pollutants from wood combustion in the ICI sectors are taken from EPA's SPECIATE database.<sup>11</sup>

Table 5 in the appendix lists all emissions factors for the ICI sectors.

## F. Controls

There are no controls assumed for this category. However, the ICI tool includes options for SLT agencies to submit pollutant-, SCC-, and county-specific control factors if needed. These control factors are a number between 0 and 1 that is multiplied by the emissions for that pollutant, SCC, and county. These factors allow SLT agencies to “fine tune” emissions estimates based on their understanding of how specific national and local rules combined with their penetration/effectiveness could lead to “composite-rule” emission factors for specific counties and pollutants. The relative difference between these “composite-rule” and default ICI tool emission factors can then be used to compute SCC-, county-, and pollutant-specific “controls.”

Alternatively, SLT agencies can adjust the emissions factors; however, this would affect the calculation of emissions for all counties in the state.

## G. Emissions

Emissions in each ICI sector are estimated by multiplying the county-level nonpoint source fuel consumption by the emission factors from Table 5.

$$E_{p,f,c,x} = NPF_{f,c,x} \times EF_{p,f,x} \quad (5)$$

Where:

$$\begin{aligned} E_{p,f,c,x} &= \text{Annual emissions of pollutant } p \text{ from fuel type } f \text{ in county } c \text{ in sector } x \\ NPF_{f,c,x} &= \text{Nonpoint source consumption of fuel type } f \text{ in county } c \text{ in sector } x \\ EF_{p,f,x} &= \text{Emissions factor for pollutant } p, \text{ fuel type } f, \text{ and sector } x \end{aligned}$$

## H. Point Source Subtraction

The adjusted fuel consumption discussed in section C is an estimate of the state-level total fuel combusted for all sources, including point and nonpoint sources. To estimate the fuel consumption from only nonpoint sources, the fuel consumption from point sources is subtracted from the total adjusted fuel consumption. The fuel consumption from point sources is provided to EPA by SLT agencies.

The starting point for computing state-level point fuel consumption ( $PF_{f,s,x}$ ) begins by matching NEI (EIS/state) facility identifier codes with EIA facilities in EIA-923 data<sup>12</sup> to identify facilities that are in the industrial, commercial, or electric utility sectors. NEI facilities that match EIA-923 facilities with EIA sector assignments of 4 (Commercial NAICS Non-Co-gen) or 5 (Commercial NAICS Cogen) are assigned as “Commercial/Institutional” whose point source throughput activity data (consumption) are subject to Point subtraction from EIA SEDS. Similarly, NEI facilities that match EIA-923 facilities with EIA sector assignments of 6 (Industrial NAICS Non-Co-gen) or 7 (Industrial NAICS Cogen) are assigned as “Commercial/Institutional” whose point source throughput activity data (consumption) are subject to Point subtraction from EIA SEDS. NEI facilities that match EIA-923 facilities with EIA sector assignments of 1, 2 or 3 (Electric Utility, NAICS-22 Non-Cogen, and NAICS-22 Cogen, respectively) are assigned as “EGU” and thus not subject to Point “ICI” subtraction. An existing EIA 923 to NEI (EIS/state) facility ID cross-reference to EIA ICI sectors is available for each state

“Proposed\_facility\_to\_ICI\_sector\_assignments\_2016NEI\_14dec18\_<state>.csv” on the [2017 NEI Supporting Data site](#).

The remaining facilities that are not matched to EIA-923 facilities are then assigned to “Industrial”, “Commercial/Institutional” or “N/A” based on facility NAICS codes provided in Table 6.

Once all point facilities have been mapped to the appropriate sector via either the EIA-923 or the NAICS assignments, the point inventory fuel consumption data are then aggregated by fuels using one of four different options to identify the fuel:

- **Option A: By NAICS and SCC.** In this option, SLT agencies submit state-level point source data aggregated by NAICS code and SCC. NAICS codes are used to map the point source fuel consumption to the appropriate ICI sector according to the mapping in Table 6 in the appendix. SCCs are used to identify the type of fuel consumed, according to the mapping in Table 7 in the appendix.
- **Option B: By NAICS and Fuel Type.** If the SLT agency knows the type of fuel consumed at each facility, the agency can submit fuel consumption by fuel type and NAICS. As with option A, the NAICS code will be used to map the fuel consumption to the appropriate sector.
- **Option C: Point Source Fuel Consumption By Sector and Fuel Type.** If the SLT agency has an alternative approach for determining the state-level fuel consumption by point sources in the industrial and commercial/institutional sectors by fuel type, the agency can submit this data directly.
- **Option D: Nonpoint Source Fuel Consumption By Sector and Fuel Type.** If the SLT agency has an alternative approach for determining the state-level fuel consumption by nonpoint sources in the industrial and commercial/institutional sectors by fuel type, the agency can submit this data directly. If the SLT agency chooses this option, point source subtraction is not needed, and the nonpoint source fuel consumption will be used directly to estimate emissions without further adjustment.

$$NPF_{f,s,x} = AF_{f,s,x} - PF_{f,s,x} \quad (6)$$

Where:

$$\begin{aligned} NPF_{f,s,x} &= \text{Adjusted nonpoint consumption of fuel } f \text{ in state } s \text{ in sector } x \\ AF_{f,s,x} &= \text{Total consumption of fuel } f \text{ in state } s \text{ in sector } x, \text{ adjusted as discussed in section C} \\ PF_{f,s,x} &= \text{Consumption of fuel } f \text{ by points sources in state } s \text{ in sector } x \end{aligned}$$

Following point source subtraction at the state level, the estimated state-level nonpoint source fuel consumption is distributed to the states based on employment in the industrial and commercial sectors. This allocation procedure is discussed in section D.

## I. Sample Calculations

Table 3 lists sample calculations to determine PM<sub>25</sub>-PRI emissions from nonpoint source bituminous/subbituminous coal combustion in the industrial sector in Alamance County, North Carolina. Note that the equations in the table are listed in the order of the calculations, not in the order in which they are presented in this NEMO. Note also that the point source fuel consumption used in in equation 6 is just shown as an example and is not actual point source fuel consumption data submitted by an SLT agency.

**Table 3. Sample calculations for PM25-PRI emissions from nonpoint source bituminous/subbituminous coal combustion in the industrial sector in Alamance County, NC.**

Eq. #	Equation	Values for Alamance County, NC	Result
1	$AF_{f,s,x}$ $= TF_{f,s,x} \times SS_{f,s,x}$ $\times (1 - nc_{f,s,industrial})$	$454 \text{ thousand tons coal consumption in the industrial sector in NC} \times 1 [\text{fraction of coal used by stationary sources}] \times (1 - 0.2632 [\text{fraction of coal in NC used as input to industrial process}])$	334.5 thousand tons adjusted industrial coal consumption in NC
2	$AF_{ant/bit,s,x}$ $= AF_{coal,s,x}$ $\times R_{ant/bit,s}$	$334.5 \text{ thousand tons coal} \times 1 [\text{fraction of bit/subbit coal consumption}]$	334.5 thousand tons industrial bituminous/subbituminous coal consumption in NC
3	$AF_{boiler/engine,s,x}$ $= AF_{distillate,s,x}$ $\times R_{boiler/engine,s,x}$	N/A	Not needed for coal consumption
6	$NPF_{f,s,x}$ $= AF_{f,s,x} - PF_{f,s,x}$	$334.5 \text{ thousand tons bit/subbit coal} - 300 \text{ tons point source bit/subbit coal consumption}$	34.5 thousand tons industrial nonpoint source bituminous/subbituminous coal consumption
4	$NPF_{f,c,x}$ $= NPF_{f,s,x}$ $\times \frac{emp_{c,x}}{emp_{s,x}}$	$34.5 \text{ thousand tons} \times \frac{17,733 \text{ industrial employees in Alamance}}{861,292 \text{ industrial employees in NC}}$	0.71 thousand tons industrial nonpoint source bituminous/subbituminous coal consumption in Alamance County, NC
5	$E_{p,f,c,x}$ $= NPF_{f,c,x}$ $\times EF_{p,f,x}$	$0.71 \text{ thousand tons} \times 2.44 \text{ lbs PM25 - PRI/ton}$	1,732 lbs. (0.866 tons) PM25-PRI emissions from industrial nonpoint source bituminous/subbituminous coal consumption in Alamance County

## **J. Changes from 2014 Methodology**

The current method uses a different approach to point source subtraction compared to the 2014 method. The 2014 method used point source SCCs to identify both the sector and fuel type for fuel consumption by point sources. In the current method, the EIA-923 data is first used to assign point inventory facilities as Industrial, Commercial/Institutional, or neither, and then facilities' NAICS codes are used to determine which of the remaining facilities are in the ICI sector. The current method also now allows four different options for submitting state-level fuel consumption data.

In addition, in the current method, point source subtraction is conducted at the state level, rather than the county level. In the 2014 method, total fuel consumption was distributed to the county level before point source subtraction, and then point source subtraction was conducted using county-level point source data.

Finally, the 2014 method allowed point source subtraction using either point source emissions or point source fuel consumption. In the current method, point source subtraction is conducted using only point source fuel consumption; point source subtraction using emissions is no longer allowed.

## **K. Puerto Rico and U.S. Virgin Islands Emissions Calculations**

Since insufficient data exists to calculate emissions from the ICI sectors for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## **L. Instructions for Submitting Point Activity Data to Input Template**

The ICI Input Template has four options for submitting point inventory activity (fuel) throughput data, separately for Industrial vs Commercial/Institutional sources, which are described in Section H. When compiling the point inventory activity data, the SLT agency should first use the EIA-923 data<sup>12</sup> to run an initial sweep on their point inventory to classify facilities as Industrial, Commercial/Institutional, neither, or non-matched to EIA. In the EIA-923 data, in the "Sector" column of the tab "Page 1 Generation and Fuel Data," facilities listed as Electric Utility or NAICS 22 are considered part of the Electric Utility sector and are not included in the ICI tool. All other facilities are considered Industrial or Commercial/Institutional, as labeled in the EIA-923 data. A preliminary set of these ICI facility assignments is available for each state in the spreadsheets called: "Proposed\_facility\_to\_ICI\_sector\_assignments\_2016NEI\_14dec18\_<state>.csv" on the [2017 NEI Supporting Data site](#).

Then for facilities that are not able to be matched to the EIA-923, the SLT agency should use the NAICS codes in Table 6 to assign the remaining facilities as Industrial, Commercial/Institutional, or neither. Next, the SLT agency should use the SCC-to-fuel cross-reference in Table 7 to determine the fuel type associated with the point source activity. Fuel consumption data needs to be estimated by SCC for all processes, separately for Industrial vs Commercial/Institutional facilities. Once this is complete, SLTs then aggregate this consumption data, separately for Industrial vs Commercial/Institutional, to state total NAICS/SCC (Option A), NAICS/fuel (Option B), or point inventory total for Sector- (I vs C/I) fuel type (Option C). The templates also include a fourth option (D), which is nonpoint inventory total by sector/fuel type. We will perform quality assurance on any SLT-submitted consumption data, comparing to SEDS data. EPA cannot populate this point source fuel consumption data if SLTs do not submit it.

## M. References

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- <sup>3</sup> Energy Information Administration. 2017. Manufacturing Energy Consumption Survey. <https://www.eia.gov/consumption/manufacturing/>
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- <sup>10</sup> E.H. Pechan and Associates, Inc. 2003. Estimating Ammonia Emissions from Anthropogenic Sources, Draft Report. Durham, NC. Prepared for USEPA Emission Factor and Inventory Group.
- <sup>11</sup> EPA. 2016. SPECIATE v4.5. Fireplace wood combustion – pine wood. <https://www.epa.gov/air-emissions-modeling/speciate>
- <sup>12</sup> EIA. 2018. Form 923 Electricity Sector Data. <https://www.eia.gov/electricity/data/eia923/>

## Appendix

**Table 4. Stationary source fuel consumption assumptions by sector**

State	Industrial					Commercial					Farm		Off-Highway	Oil Company
	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	Diesel	Other Distillate	Total Distillate	Total Distillate
AL	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
AK	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
AZ	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
AR	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
CA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
CO	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
CT	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
DE	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
DC	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
FL	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
GA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
HI	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
ID	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
IL	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
IN	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
IA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
KS	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
KY	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
LA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
ME	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MD	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MI	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%

State	Industrial					Commercial					Farm		Off-Highway	Oil Company
	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	Diesel	Other Distillate	Total Distillate	Total Distillate
MN	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MS	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MO	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
MT	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NE	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NV	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NH	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NJ	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NM	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NY	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
NC	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
ND	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
OH	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
OK	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
OR	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
PA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
RI	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
SC	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
SD	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
TN	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
TX	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
UT	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
VT	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
VA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
WA	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
WV	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%
WI	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%

State	Industrial					Commercial					Farm		Off-Highway	Oil Company
	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	No. 1 Distillate	No. 2 Fuel Oil	No. 2 Low Sulfur Distillate	No. 4 Distillate	LPG	Diesel	Other Distillate	Total Distillate	Total Distillate
WY	60%	100%	15%	100%	91.28%	80%	100%	0%	100%	82.28%	0%	100%	5%	50%

**Note:** Farm, off-highway, and oil company sectors are mapped to the industrial sector for the ICI tool.

**Table 5. Emissions factors for fuel consumption in the Industrial, Commercial, and Institutional sectors. Note: the original emissions factor is included in the table if it has different units in the original source and has been converted for use in the ICI tool**

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102001000	85018	Phenanthrene				0.0068	LB	TON	7; Table 1.2-5
2102001000	91203	Naphthalene				0.13	LB	TON	7; Table 1.2-5
2102001000	92524	Biphenyl				0.025	LB	TON	7; Table 1.2-5
2102001000	7439921	Lead				0.00042	LB	TON	7; Table 1.2-3
2102001000	CO	Carbon Monoxide				0.6	LB	TON	8
2102001000	NH3	Ammonia				0.03	LB	TON	8
2102001000	NOX	Nitrogen Oxides				9	LB	TON	8
2102001000	PM10-FIL	PM10 Filterable				1.1A	LB	TON	8
2102001000	PM10-PRI	PM10 Primary (Filt + Cond)				0.08A + 1.1A	LB	TON	8
2102001000	PM25-FIL	PM2.5 Filterable				0.48A	LB	TON	8
2102001000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.08A + 0.48A	LB	TON	8
2102001000	PM-CON	PM Condensable				0.08A	LB	TON	8
2102001000	SO2	Sulfur Dioxide				38S	LB	TON	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102001000	VOC	Volatile Organic Compounds				0.3	LB	TON	8
2102002000	50000	Formaldehyde				0.00024	LB	TON	7; Table 1.1-14
2102002000	50328	Benzo[a]Pyrene				0.000000038	LB	TON	7; Table 1.1-13
2102002000	56553	Benz[a]Anthracene				0.00000008	LB	TON	7; Table 1.1-13
2102002000	60344	Methylhydrazine				0.00017	LB	TON	7; Table 1.1-14
2102002000	67663	Chloroform				0.000059	LB	TON	7; Table 1.1-14
2102002000	75003	Ethyl Chloride				0.000042	LB	TON	7; Table 1.1-14
2102002000	75252	Bromoform				0.000039	LB	TON	7; Table 1.1-14
2102002000	77781	Dimethyl Sulfate				0.000048	LB	TON	7; Table 1.1-14
2102002000	80626	Methyl Methacrylate				0.00002	LB	TON	7; Table 1.1-14
2102002000	83329	Acenaphthene				0.00000051	LB	TON	7; Table 1.1-13
2102002000	85018	Phenanthrene				0.0000027	LB	TON	7; Table 1.1-13
2102002000	86737	Fluorene				0.00000091	LB	TON	7; Table 1.1-13
2102002000	91203	Naphthalene				0.000013	LB	TON	7; Table 1.1-13
2102002000	92524	Biphenyl				0.0000017	LB	TON	7; Table 1.1-13
2102002000	98828	Cumene				0.0000053	LB	TON	7; Table 1.1-14
2102002000	100447	Benzyl Chloride				0.0007	LB	TON	7; Table 1.1-14
2102002000	106934	Ethylene Dibromide				0.0000012	LB	TON	7; Table 1.1-14
2102002000	108054	Vinyl Acetate				0.0000076	LB	TON	7; Table 1.1-14
2102002000	120127	Anthracene				0.00000021	LB	TON	7; Table 1.1-13
2102002000	121142	2,4-Dinitrotoluene				0.00000028	LB	TON	7; Table 1.1-14
2102002000	129000	Pyrene				0.00000033	LB	TON	7; Table 1.1-13
2102002000	191242	Benzo[g,h,i]Perylene				0.000000027	LB	TON	7; Table 1.1-13
2102002000	193395	Indeno[1,2,3-c,d]Pyrene				0.000000061	LB	TON	7; Table 1.1-13
2102002000	206440	Fluoranthene				0.00000071	LB	TON	7; Table 1.1-13
2102002000	208968	Acenaphthylene				0.00000025	LB	TON	7; Table 1.1-13
2102002000	218019	Chrysene				0.0000001	LB	TON	7; Table 1.1-13
2102002000	532274	2-Chloroacetophenone				0.000007	LB	TON	7; Table 1.1-14

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102002000	1330207	Xylenes (Mixed Isomers)				0.000037	LB	TON	7; Table 1.1-14
2102002000	1634044	Methyl Tert-Butyl Ether				0.000035	LB	TON	7; Table 1.1-14
2102002000	3697243	5-Methylchrysene				0.000000022	LB	TON	7; Table 1.1-13
2102002000	7439921	Lead				0.00042	LB	TON	7; Table 1.2-3
2102002000	56832736	Benzofluoranthenes				0.000000011	LB	TON	7; Table 1.1-14
2102002000	CO	Carbon Monoxide				5	LB	TON	7; Table 1.1-3
2102002000	NH3	Ammonia				0.03	LB	TON	9
2102002000	NOX	Nitrogen Oxides				11	LB	TON	7; Table 1.1-3
2102002000	PM10-FIL	PM10 Filterable				12	LB	TON	8
2102002000	PM10-PRI	PM10 Primary (Filt + Cond)				13.04	LB	TON	8
2102002000	PM25-FIL	PM2.5 Filterable				1.4	LB	TON	8
2102002000	PM25-PRI	PM2.5 Primary (Filt + Cond)				2.44	LB	TON	8
2102002000	PM-CON	PM Condensible				1.04	LB	TON	8
2102002000	SO2	Sulfur Dioxide				38S	LB	TON	8
2102002000	VOC	Volatile Organic Compounds				0.05	LB	TON	8
2102004001	50000	Formaldehyde				0.048	LB	E3GAL	7; Table 1.3-8
2102004001	7439921	Lead				1.51E-03	LB	E3GAL	7; Table 1.3-11
2102004001	CO	Carbon Monoxide				5	LB	E3GAL	7; Table 1.3-1
2102004001	NH3	Ammonia				0.8	LB	E3GAL	9
2102004001	NOX	Nitrogen Oxides				20	LB	E3GAL	7; Table 1.3-1
2102004001	PM10-FIL	PM10 Filterable				5.9A	LB	E3GAL	7; Table 1.3-1
2102004001	PM10-PRI	PM10 Primary (Filt + Cond)				5.9A + 1.3	LB	E3GAL	7; Tables 1.3-1 1.3-2
2102004001	PM25-FIL	PM2.5 Filterable				4.3A	LB	E3GAL	7; Table 1.3-1
2102004001	PM25-PRI	PM2.5 Primary (Filt + Cond)				4.3A + 1.3	LB	E3GAL	7; Tables 1.3-1 1.3-2

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102004001	PM-CON	PM Condensable				1.3	LB	E3GAL	7; Table 1.3-2
2102004001	SO2	Sulfur Dioxide				2S	LB	E3GAL	7; Table 1.3-1
2102004001	VOC	Volatile Organic Compounds				0.2	LB	E3GAL	7; Table 1.3-3
2102004002	50000	Formaldehyde	1.18E-03	LB	MMBTU	0.16166	LB	E3GAL	7; Table 3.3-2
2102004002	50328	Benzo[a]Pyrene	1.88E-07	LB	MMBTU	0.000025756	LB	E3GAL	7; Table 3.3-2
2102004002	53703	Dibenzo[a,h]Anthracene	5.83E-07	LB	MMBTU	0.000079871	LB	E3GAL	7; Table 3.3-2
2102004002	56553	Benz[a]Anthracene	1.68E-06	LB	MMBTU	0.00023016	LB	E3GAL	7; Table 3.3-2
2102004002	71432	Benzene	9.33E-04	LB	MMBTU	0.127821	LB	E3GAL	7; Table 3.3-2
2102004002	75070	Acetaldehyde	7.67E-04	LB	MMBTU	0.105079	LB	E3GAL	7; Table 3.3-2
2102004002	83329	Acenaphthene	5.06E-06	LB	MMBTU	0.00019454	LB	E3GAL	7; Table 3.3-2
2102004002	85018	Phenanthrene	2.94E-05	LB	MMBTU	0.0040278	LB	E3GAL	7; Table 3.3-2
2102004002	86737	Fluorene	2.92E-05	LB	MMBTU	0.0040004	LB	E3GAL	7; Table 3.3-2
2102004002	91203	Naphthalene	8.48E-05	LB	MMBTU	0.0116176	LB	E3GAL	7; Table 3.3-2
2102004002	106990	1,3-Butadiene	3.91E-05	LB	MMBTU	0.0053567	LB	E3GAL	7; Table 3.3-2
2102004002	107028	Acrolein	9.25E-05	LB	MMBTU	0.0126725	LB	E3GAL	7; Table 3.3-2
2102004002	108883	Toluene	4.09E-04	LB	MMBTU	0.056033	LB	E3GAL	7; Table 3.3-2
2102004002	120127	Anthracene	1.87E-06	LB	MMBTU	0.00025619	LB	E3GAL	7; Table 3.3-2
2102004002	129000	Pyrene	4.78E-06	LB	MMBTU	0.00065486	LB	E3GAL	7; Table 3.3-2
2102004002	191242	Benzo[g,h,i]Perylene	4.89E-07	LB	MMBTU	0.000066993	LB	E3GAL	7; Table 3.3-2
2102004002	193395	Indeno[1,2,3-c,d]Pyrene	3.75E-07	LB	MMBTU	0.000051375	LB	E3GAL	7; Table 3.3-2
2102004002	205992	Benzo[b]Fluoranthene	9.91E-08	LB	MMBTU	1.35767E-05	LB	E3GAL	7; Table 3.3-2
2102004002	206440	Fluoranthene	7.61E-06	LB	MMBTU	0.00104257	LB	E3GAL	7; Table 3.3-2
2102004002	207089	Benzo[k]Fluoranthene	1.55E-07	LB	MMBTU	0.000021235	LB	E3GAL	7; Table 3.3-2
2102004002	208968	Acenaphthylene	5.06E-06	LB	MMBTU	0.00069322	LB	E3GAL	7; Table 3.3-2
2102004002	218019	Chrysene	3.53E-07	LB	MMBTU	0.000048361	LB	E3GAL	7; Table 3.3-2
2102004002	1330207	Xylenes (Mixed Isomers)	2.85E-04	LB	MMBTU	0.039045	LB	E3GAL	7; Table 3.3-2
2102004002	CO	Carbon Monoxide	0.95	LB	MMBTU	130	LB	E3GAL	7; Table 3.3-1
2102004002	NH3	Ammonia				0.8	LB	E3GAL	9

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102004002	NOX	Nitrogen Oxides	4.41	LB	MMBTU	604	LB	E3GAL	7; Table 3.3-1
2102004002	PM10-FIL	PM10 Filterable	0.31	LB	MMBTU	42.5	LB	E3GAL	7; Table 3.3-1
2102004002	PM10-PRI	PM10 Primary (Filt + Cond)				43.5	LB	E3GAL	Sum of PM10-FIL and PM-CON
2102004002	PM25-FIL	PM2.5 Filterable				39.8	LB	E3GAL	Determined used PM Augmentation Tool
2102004002	PM25-PRI	PM2.5 Primary (Filt + Cond)				40.8	LB	E3GAL	Sum of PM25-FIL and PM-CON
2102004002	PM-CON	PM Condensible				1	LB	E3GAL	Determined used PM Augmentation Tool
2102004002	SO2	Sulfur Dioxide	0.29	LB	MMBTU	39.8	LB	E3GAL	7; Table 3.3-1
2102004002	VOC	Volatile Organic Compounds	0.36	LB	MMBTU	42	LB	E3GAL	7; Table 3.3-1
2102005000	50000	Formaldehyde				0.033	LB	E3GAL	7; Table 1.3-9
2102005000	53703	Dibenzo[a,h]Anthracene				0.00000167	LB	E3GAL	7; Table 1.3-9
2102005000	56553	Benz[a]Anthracene				0.00000401	LB	E3GAL	7; Table 1.3-9
2102005000	71432	Benzene				0.000214	LB	E3GAL	7; Table 1.3-9
2102005000	75070	Acetaldehyde				0.00525	LB	E3GAL	2002 NEI Documentation
2102005000	83329	Acenaphthene				0.0000211	LB	E3GAL	7; Table 1.3-9
2102005000	85018	Phenanthrene				0.0000105	LB	E3GAL	7; Table 1.3-9
2102005000	86737	Fluorene				0.0000047	LB	E3GAL	7; Table 1.3-9
2102005000	91203	Naphthalene				0.0013	LB	E3GAL	7; Table 1.3-9
2102005000	120127	Anthracene				1.22E-06	LB	E3GAL	7; Table 1.3-9
2102005000	129000	Pyrene				0.00000425	LB	E3GAL	7; Table 1.3-9
2102005000	191242	Benzo[g,h,i]Perylene				0.000002426	LB	E3GAL	7; Table 1.3-9
2102005000	193395	Indeno[1,2,3-c,d]Pyrene				0.00000214	LB	E3GAL	7; Table 1.3-9
2102005000	206440	Fluoranthene				0.00000484	LB	E3GAL	7; Table 1.3-9
2102005000	208968	Acenaphthylene				0.000000211	LB	E3GAL	7; Table 1.3-9

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102005000	218019	Chrysene				0.00000238	LB	E3GAL	7; Table 1.3-9
2102005000	7439921	Lead	9	LB	E12BTU	0.001233	LB	E3GAL	7; Table 1.3-10
2102005000	56832736	Benzofluoranthenes				0.00000148	LB	E3GAL	7; Table 1.3-9
2102005000	CO	Carbon Monoxide				5	LB	E3GAL	8
2102005000	NH3	Ammonia				0.8	LB	E3GAL	8
2102005000	NOX	Nitrogen Oxides				55	LB	E3GAL	8
2102005000	PM10-FIL	PM10 Filterable				7.17(1.12*S+0.37)	LB	E3GAL	8
2102005000	PM10-PRI	PM10 Primary (Filt + Cond)					LB	E3GAL	8
2102005000	PM25-FIL	PM2.5 Filterable				4.67(1.12*S+0.37)	LB	E3GAL	8
2102005000	PM25-PRI	PM25 Primary (Filt + Cond)					LB	E3GAL	8
2102005000	PM-CON	PM Condensible				1.5	LB	E3GAL	8
2102005000	SO2	Sulfur Dioxide				157S	LB	E3GAL	8
2102005000	VOC	Volatile Organic Compounds				0.28	LB	E3GAL	8
2102006000	50000	Formaldehyde				0.075	LB	E6FT3	7; Table 1.4-3
2102006000	71432	Benzene				0.0021	LB	E6FT3	7; Table 1.4-3
2102006000	75070	Acetaldehyde				0.00001365	LB	E6FT3	2002 NEI Documentation
2102006000	85018	Phenanthrene				0.0000175	LB	E6FT3	7; Table 1.4-3
2102006000	86737	Fluorene				2.80E-06	LB	E6FT3	7; Table 1.4-3
2102006000	91203	Naphthalene				6.10E-04	LB	E6FT3	7; Table 1.4-3
2102006000	129000	Pyrene				5.00E-06	LB	E6FT3	7; Table 1.4-3
2102006000	206440	Fluoranthene				3.00E-06	LB	E6FT3	7; Table 1.4-3
2102006000	7439921	Lead				0.0005	LB	E6FT3	7; Table 1.4-2
2102006000	CO	Carbon Monoxide				84	LB	E6FT3	8
2102006000	NH3	Ammonia				3.2	LB	E6FT3	8
2102006000	NOX	Nitrogen Oxides				100	LB	E6FT3	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102006000	PM10-FIL	PM10 Filterable				0.2	LB	E6FT3	8
2102006000	PM10-PRI	PM10 Primary (Filt + Cond)				0.54	LB	E6FT3	8
2102006000	PM25-FIL	PM2.5 Filterable				0.11	LB	E6FT3	8
2102006000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.43	LB	E6FT3	8
2102006000	PM-CON	PM Condensible				0.32	LB	E6FT3	8
2102006000	SO2	Sulfur Dioxide				0.6	LB	E6FT3	8
2102006000	VOC	Volatile Organic Compounds				5.5	LB	E6FT3	8
2102007000	CO	Carbon Monoxide				7.97	LB	E3GAL	8
2102007000	NH3	Ammonia				0.3	LB	E3GAL	8
2102007000	NOX	Nitrogen Oxides				14.23	LB	E3GAL	8
2102007000	PM10-FIL	PM10 Filterable				0.02	LB	E3GAL	8
2102007000	PM10-PRI	PM10 Primary (Filt + Cond)				0.05	LB	E3GAL	8
2102007000	PM25-FIL	PM2.5 Filterable				0.01	LB	E3GAL	8
2102007000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.04	LB	E3GAL	8
2102007000	PM-CON	PM Condensible				0.03	LB	E3GAL	8
2102007000	SO2	Sulfur Dioxide				0.06	LB	E3GAL	8
2102007000	VOC	Volatile Organic Compounds				0.52	LB	E3GAL	8
2102008000	50000	Formaldehyde				0.00144053	LB	E6BTU	11
2102008000	71432	Benzene				0.000473582	LB	E6BTU	11
2102008000	75070	Acetaldehyde				0.002107007	LB	E6BTU	11
2102008000	83329	Acenaphthene				2.49774E-06	LB	E6BTU	11
2102008000	85018	Phenanthrene				1.94131E-05	LB	E6BTU	11
2102008000	86737	Fluorene				5.49009E-06	LB	E6BTU	11

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102008000	90120	1-Methylnaphthalene				1.3107E-05	LB	E6BTU	11
2102008000	91203	Naphthalene				0.000280687	LB	E6BTU	11
2102008000	91576	2-Methylnaphthalene				1.85476E-05	LB	E6BTU	11
2102008000	98862	Acetophenone				4.82237E-06	LB	E6BTU	11
2102008000	100414	Ethyl Benzene				2.8316E-05	LB	E6BTU	11
2102008000	106990	1,3-Butadiene				0.000144671	LB	E6BTU	11
2102008000	107028	Acrolein				7.78999E-05	LB	E6BTU	11
2102008000	108883	Toluene				0.000195368	LB	E6BTU	11
2102008000	108952	Phenol				0.000649166	LB	E6BTU	11
2102008000	120127	Anthracene				4.25358E-06	LB	E6BTU	11
2102008000	120809	Catechol				0.00038579	LB	E6BTU	11
2102008000	123319	Hydroquinone				2.12679E-05	LB	E6BTU	11
2102008000	123386	Propionaldehyde				0.000315309	LB	E6BTU	11
2102008000	129000	Pyrene				2.31227E-06	LB	E6BTU	11
2102008000	203123	Benzo(g,h,i)Fluoranthene				1.01394E-07	LB	E6BTU	11
2102008000	206440	Fluoranthene				3.77134E-06	LB	E6BTU	11
2102008000	208968	Acenaphthylene				2.2999E-05	LB	E6BTU	11
2102008000	832699	1-Methylphenanthrene				2.74504E-06	LB	E6BTU	11
2102008000	1319773	Cresol/Cresylic Acid (Mixed Isomers)				0.000580663	LB	E6BTU	11
2102008000	1330207	Xylenes (Mixed Isomers)				9.65711E-05	LB	E6BTU	11
2102008000	CO	Carbon Monoxide				0.6	LB	E6BTU	7; Section 1.6
2102008000	NH3	Ammonia				0.007	LB	E6BTU	10
2102008000	NOX	Nitrogen Oxides				0.22	LB	E6BTU	7; Section 1.6
2102008000	PM10-FIL	PM10 Filterable				0.5	LB	E6BTU	7; Section 1.6
2102008000	PM10-PRI	PM10 Primary (Filt + Cond)				0.517	LB	E6BTU	7; Section 1.6
2102008000	PM25-FIL	PM2.5 Filterable				0.43	LB	E6BTU	7; Section 1.6

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102008000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.447	LB	E6BTU	7; Section 1.6
2102008000	PM-CON	PM Condensable				0.017	LB	E6BTU	7; Section 1.6
2102008000	SO2	Sulfur Dioxide				0.025	LB	E6BTU	7; Section 1.6
2102008000	VOC	Volatile Organic Compounds				0.017	LB	E6BTU	7; Section 1.6
2102011000	50000	Formaldehyde				0.0324	LB	E3GAL	7; Table 1.3-9
2102011000	53703	Dibenzo[a,h]Anthracene				0.00000162	LB	E3GAL	7; Table 1.3-9
2102011000	56553	Benz[a]Anthracene				0.000003915	LB	E3GAL	7; Table 1.3-9
2102011000	71432	Benzene				0.0002025	LB	E3GAL	7; Table 1.3-9
2102011000	75070	Acetaldehyde				0.004725	LB	E3GAL	7; Table 1.3-9
2102011000	83329	Acenaphthene				0.00002025	LB	E3GAL	7; Table 1.3-9
2102011000	85018	Phenanthrene				0.000010125	LB	E3GAL	7; Table 1.3-9
2102011000	86737	Fluorene				0.00000432	LB	E3GAL	7; Table 1.3-9
2102011000	91203	Naphthalene				0.0010935	LB	E3GAL	7; Table 1.3-9
2102011000	120127	Anthracene				1.1745E-06	LB	E3GAL	7; Table 1.3-9
2102011000	129000	Pyrene				0.00000405	LB	E3GAL	7; Table 1.3-9
2102011000	191242	Benzo[g,h,i,]Perylene				0.00000216	LB	E3GAL	7; Table 1.3-9
2102011000	193395	Indeno[1,2,3-c,d]Pyrene				0.000002025	LB	E3GAL	7; Table 1.3-9
2102011000	206440	Fluoranthene				0.000004725	LB	E3GAL	7; Table 1.3-9
2102011000	208968	Acenaphthylene				0.000000243	LB	E3GAL	7; Table 1.3-9
2102011000	218019	Chrysene				0.000002295	LB	E3GAL	7; Table 1.3-9
2102011000	7439921	Lead				0.001215	LB	E3GAL	7; Table 1.3-9
2102011000	56832736	Benzofluoranthenes				0.000001485	LB	E3GAL	7; Table 1.3-9
2102011000	CO	Carbon Monoxide				4.82	LB	E3GAL	8
2102011000	NH3	Ammonia				0.77	LB	E3GAL	8
2102011000	NOX	Nitrogen Oxides				19.29	LB	E3GAL	8
2102011000	PM10-FIL	PM10 Filterable				0.96	LB	E3GAL	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2102011000	PM10-PRI	PM10 Primary (Filt + Cond)				2.21	LB	E3GAL	8
2102011000	PM25-FIL	PM2.5 Filterable				0.24	LB	E3GAL	8
2102011000	PM25-PRI	PM2.5 Primary (Filt + Cond)				1.49	LB	E3GAL	8
2102011000	PM-CON	PM Condensible				1.25	LB	E3GAL	8
2102011000	SO2	Sulfur Dioxide				142S	LB	E3GAL	8
2102011000	VOC	Volatile Organic Compounds				0.19	LB	E3GAL	8
2103001000	85018	Phenanthrene				0.0068	LB	TON	7; Table 1.2-5
2103001000	91203	Naphthalene				0.13	LB	TON	7; Table 1.2-5
2103001000	92524	Biphenyl				0.025	LB	TON	7; Table 1.2-5
2103001000	7439921	Lead				0.00042	LB	TON	7; Table 1.2-3
2103001000	CO	Carbon Monoxide				0.6	LB	TON	8
2103001000	NH3	Ammonia				0.03	LB	TON	8
2103001000	NOX	Nitrogen Oxides				9	LB	TON	8
2103001000	PM10-FIL	PM10 Filterable				14.718	LB	TON	8
2103001000	PM10-PRI	PM10 Primary (Filt + Cond)				15.7884	LB	TON	8
2103001000	PM25-FIL	PM2.5 Filterable				6.4224	LB	TON	8
2103001000	PM25-PRI	PM2.5 Primary (Filt + Cond)				7.4928	LB	TON	8
2103001000	PM-CON	PM Condensible				1.0704	LB	TON	8
2103001000	SO2	Sulfur Dioxide				142S	LB	TON	8
2103001000	VOC	Volatile Organic Compounds				0.3	LB	TON	8
2103002000	50000	Formaldehyde				0.00024	LB	TON	7; Table 1.1-14
2103002000	50328	Benzo[a]Pyrene				0.000000038	LB	TON	7; Table 1.1-13
2103002000	56553	Benz[a]Anthracene				0.00000008	LB	TON	7; Table 1.1-13
2103002000	60344	Methylhydrazine				0.00017	LB	TON	7; Table 1.1-14

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103002000	67663	Chloroform				0.000059	LB	TON	7; Table 1.1-14
2103002000	75003	Ethyl Chloride				0.000042	LB	TON	7; Table 1.1-14
2103002000	75252	Bromoform				0.000039	LB	TON	7; Table 1.1-14
2103002000	77781	Dimethyl Sulfate				0.000048	LB	TON	7; Table 1.1-14
2103002000	80626	Methyl Methacrylate				0.00002	LB	TON	7; Table 1.1-14
2103002000	83329	Acenaphthene				0.00000051	LB	TON	7; Table 1.1-13
2103002000	85018	Phenanthrene				0.0000027	LB	TON	7; Table 1.1-13
2103002000	86737	Fluorene				0.00000091	LB	TON	7; Table 1.1-13
2103002000	91203	Naphthalene				0.000013	LB	TON	7; Table 1.1-13
2103002000	92524	Biphenyl				0.0000017	LB	TON	7; Table 1.1-13
2103002000	98828	Cumene				0.0000053	LB	TON	7; Table 1.1-14
2103002000	100447	Benzyl Chloride				0.0007	LB	TON	7; Table 1.1-14
2103002000	106934	Ethylene Dibromide				0.0000012	LB	TON	7; Table 1.1-14
2103002000	108054	Vinyl Acetate				0.0000076	LB	TON	7; Table 1.1-14
2103002000	120127	Anthracene				0.00000021	LB	TON	7; Table 1.1-13
2103002000	121142	2,4-Dinitrotoluene				0.00000028	LB	TON	7; Table 1.1-14
2103002000	129000	Pyrene				0.00000033	LB	TON	7; Table 1.1-13
2103002000	191242	Benzo[g,h,i]Perylene				0.000000027	LB	TON	7; Table 1.1-13
2103002000	193395	Indeno[1,2,3-c,d]Pyrene				0.000000061	LB	TON	7; Table 1.1-13
2103002000	206440	Fluoranthene				0.00000071	LB	TON	7; Table 1.1-13
2103002000	208968	Acenaphthylene				0.00000025	LB	TON	7; Table 1.1-13
2103002000	218019	Chrysene				0.0000001	LB	TON	7; Table 1.1-13
2103002000	532274	2-Chloroacetophenone				0.000007	LB	TON	7; Table 1.1-14
2103002000	1330207	Xylenes (Mixed Isomers)				0.000037	LB	TON	7; Table 1.1-14
2103002000	1634044	Methyl Tert-Butyl Ether				0.000035	LB	TON	7; Table 1.1-14
2103002000	3697243	5-Methylchrysene				0.000000022	LB	TON	7; Table 1.1-13
2103002000	7439921	Lead				0.00042	LB	TON	7; Table 1.2-3
2103002000	56832736	Benzofluoranthenes				0.00000011	LB	TON	7; Table 1.1-13
2103002000	CO	Carbon Monoxide				5	LB	TON	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103002000	NH3	Ammonia				0.03	LB	TON	8
2103002000	NOX	Nitrogen Oxides				11	LB	TON	8
2103002000	PM10-FIL	PM10 Filterable				1.1A	LB	TON	8
2103002000	PM10-PRI	PM10 Primary (Filt + Cond)				1.1A + 1.04	LB	TON	8
2103002000	PM25-FIL	PM2.5 Filterable				1.4	LB	TON	8
2103002000	PM25-PRI	PM2.5 Primary (Filt + Cond)				2.44	LB	TON	8
2103002000	PM-CON	PM Condensible				1.04	LB	TON	8
2103002000	SO2	Sulfur Dioxide				38S	LB	TON	8
2103002000	VOC	Volatile Organic Compounds				0.05	LB	TON	8
2103004001	50000	Formaldehyde				0.048	LB	E3GAL	7; Table 1.3-8
2103004001	71432	Benzene				2.14E-04	LB	E3GAL	7; Table 1.3-9
2103004001	206440	Fluoranthene				4.84E-06	LB	E3GAL	7; Table 1.3-9
2103004001	7439921	Lead	9	LB	E12BTU	0.00123	LB	E3GAL	7; Table 1.3-10
2103004001	CO	Carbon Monoxide				5	LB	E3GAL	7; Table 1.3-1
2103004001	NH3	Ammonia				0.8	LB	E3GAL	9
2103004001	NOX	Nitrogen Oxides				20	LB	E3GAL	7; Table 1.3-1
2103004001	PM10-FIL	PM10 Filterable				1	LB	E3GAL	7; Table 1.3-4
2103004001	PM10-PRI	PM10 Primary (Filt + Cond)				2.38	LB	E3GAL	Sum of PM10-FIL and PM-CON emission factors
2103004001	PM25-FIL	PM2.5 Filterable				0.25	LB	E3GAL	Sum of PM25-FIL and PM-CON emission factors
2103004001	PM25-PRI	PM2.5 Primary (Filt + Cond)				2.13	LB	E3GAL	Sum of PM25-FIL and PM-CON emission factors
2103004001	PM-CON	PM Condensible				1.3	LB	E3GAL	7; Table 1.3-2
2103004001	SO2	Sulfur Dioxide				2S	LB	E3GAL	7; Table 1.3-1

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103004001	VOC	Volatile Organic Compounds				0.34	LB	E3GAL	7; Table 1.3-2
2103004002	50000	Formaldehyde	1.18E-03	LB	MMBTU	0.16166	LB	E3GAL	7; Table 3.3-2
2103004002	50328	Benzo[a]Pyrene	1.88E-07	LB	MMBTU	0.000025756	LB	E3GAL	7; Table 3.3-2
2103004002	53703	Dibenzo[a,h]Anthracene	5.83E-07	LB	MMBTU	0.000079871	LB	E3GAL	7; Table 3.3-2
2103004002	56553	Benz[a]Anthracene	1.68E-06	LB	MMBTU	0.00023016	LB	E3GAL	7; Table 3.3-2
2103004002	71432	Benzene	9.33E-04	LB	MMBTU	0.127821	LB	E3GAL	7; Table 3.3-2
2103004002	75070	Acetaldehyde	7.67E-04	LB	MMBTU	0.105079	LB	E3GAL	7; Table 3.3-2
2103004002	83329	Acenaphthene	5.06E-06	LB	MMBTU	0.00019454	LB	E3GAL	7; Table 3.3-2
2103004002	85018	Phenanthrene	2.94E-05	LB	MMBTU	0.0040278	LB	E3GAL	7; Table 3.3-2
2103004002	86737	Fluorene	2.92E-05	LB	MMBTU	0.0040004	LB	E3GAL	7; Table 3.3-2
2103004002	91203	Naphthalene	8.48E-05	LB	MMBTU	0.0116176	LB	E3GAL	7; Table 3.3-2
2103004002	106990	1,3-Butadiene	3.91E-05	LB	MMBTU	0.0053567	LB	E3GAL	7; Table 3.3-2
2103004002	107028	Acrolein	9.25E-05	LB	MMBTU	0.0126725	LB	E3GAL	7; Table 3.3-2
2103004002	108883	Toluene	4.09E-04	LB	MMBTU	0.056033	LB	E3GAL	7; Table 3.3-2
2103004002	120127	Anthracene	1.87E-06	LB	MMBTU	0.00025619	LB	E3GAL	7; Table 3.3-2
2103004002	129000	Pyrene	4.78E-06	LB	MMBTU	0.00065486	LB	E3GAL	7; Table 3.3-2
2103004002	191242	Benzo[g,h,i,]Perylene	4.89E-07	LB	MMBTU	0.000066993	LB	E3GAL	7; Table 3.3-2
2103004002	193395	Indeno[1,2,3-c,d]Pyrene	3.75E-07	LB	MMBTU	0.000051375	LB	E3GAL	7; Table 3.3-2
2103004002	205992	Benzo[b]Fluoranthene	9.91E-08	LB	MMBTU	1.35767E-05	LB	E3GAL	7; Table 3.3-2
2103004002	206440	Fluoranthene	7.61E-06	LB	MMBTU	0.00104257	LB	E3GAL	7; Table 3.3-2
2103004002	207089	Benzo[k]Fluoranthene	1.55E-07	LB	MMBTU	0.000021235	LB	E3GAL	7; Table 3.3-2
2103004002	208968	Acenaphthylene	5.06E-06	LB	MMBTU	0.00069322	LB	E3GAL	7; Table 3.3-2
2103004002	218019	Chrysene	3.53E-07	LB	MMBTU	0.000048361	LB	E3GAL	7; Table 3.3-2
2103004002	1330207	Xylenes (Mixed Isomers)	2.85E-04	LB	MMBTU	0.039045	LB	E3GAL	7; Table 3.3-2
2103004002	CO	Carbon Monoxide	0.95	LB	MMBTU	130	LB	E3GAL	7; Table 3.3-1
2103004002	NH3	Ammonia				0.8	LB	E3GAL	9
2103004002	NOX	Nitrogen Oxides	4.41	LB	MMBTU	604	LB	E3GAL	7; Table 3.3-1
2103004002	PM10-FIL	PM10 Filterable	0.31	LB	MMBTU	42.5	LB	E3GAL	7; Table 3.3-1

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103004002	PM10-PRI	PM10 Primary (Filt + Cond)				43.5	LB	E3GAL	Sum of PM10-FIL and PM-CON
2103004002	PM25-FIL	PM2.5 Filterable	0.31	LB	MMBTU	42.5	LB	E3GAL	7; Table 3.3-1
2103004002	PM25-PRI	PM2.5 Primary (Filt + Cond)				43.5	LB	E3GAL	Sum of PM25-FIL and PM-CON
2103004002	PM-CON	PM Condensible				1	LB	E3GAL	Determined used PM Augmentation Tool
2103004002	SO2	Sulfur Dioxide	0.29	LB	MMBTU	39.8	LB	E3GAL	7; Table 3.3-1
2103004002	VOC	Volatile Organic Compounds	0.36	LB	MMBTU	42	LB	E3GAL	7; Table 3.3-1
2103005000	50000	Formaldehyde				0.033	LB	E3GAL	7; Table 1.3-9
2103005000	53703	Dibenzo[a,h]Anthracene				0.00000167	LB	E3GAL	7; Table 1.3-9
2103005000	56553	Benz[a]Anthracene				0.00000401	LB	E3GAL	7; Table 1.3-9
2103005000	71432	Benzene				0.000214	LB	E3GAL	7; Table 1.3-9
2103005000	75070	Acetaldehyde				0.00525	LB	E3GAL	2002 NEI Documentation
2103005000	83329	Acenaphthene				0.0000211	LB	E3GAL	7; Table 1.3-9
2103005000	85018	Phenanthrene				0.0000105	LB	E3GAL	7; Table 1.3-9
2103005000	86737	Fluorene				0.0000047	LB	E3GAL	7; Table 1.3-9
2103005000	91203	Naphthalene				0.0013	LB	E3GAL	7; Table 1.3-9
2103005000	120127	Anthracene				1.22E-06	LB	E3GAL	7; Table 1.3-9
2103005000	129000	Pyrene				0.00000425	LB	E3GAL	7; Table 1.3-9
2103005000	191242	Benzo[g,h,i]Perylene				0.000002426	LB	E3GAL	7; Table 1.3-9
2103005000	193395	Indeno[1,2,3-c,d]Pyrene				0.00000214	LB	E3GAL	7; Table 1.3-9
2103005000	206440	Fluoranthene				0.00000484	LB	E3GAL	7; Table 1.3-9
2103005000	208968	Acenaphthylene				0.000000211	LB	E3GAL	7; Table 1.3-9
2103005000	218019	Chrysene				0.00000238	LB	E3GAL	7; Table 1.3-9
2103005000	7439921	Lead				0.001233	LB	E3GAL	7; Table 1.3-10
2103005000	56832736	Benzofluoranthenes				0.00000148	LB	E3GAL	7; Table 1.3-9
2103005000	CO	Carbon Monoxide				5	LB	E3GAL	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103005000	NH3	Ammonia				0.8	LB	E3GAL	8
2103005000	NOX	Nitrogen Oxides				55	LB	E3GAL	8
2103005000	PM10-FIL	PM10 Filterable				1.92(1.12*S+0.37)	LB	E3GAL	8
2103005000	PM10-PRI	PM10 Primary (Filt + Cond)					LB	E3GAL	8
2103005000	PM25-FIL	PM2.5 Filterable				5.17(1.12*S+0.37)	LB	E3GAL	8
2103005000	PM25-PRI	PM2.5 Primary (Filt + Cond)					LB	E3GAL	8
2103005000	PM-CON	PM Condensible				1.5	LB	E3GAL	8
2103005000	SO2	Sulfur Dioxide				157S	LB	E3GAL	8
2103005000	VOC	Volatile Organic Compounds				1.13	LB	E3GAL	8
2103006000	50000	Formaldehyde				7.50E-02	LB	E6FT3	7; Table 1.4-3
2103006000	71432	Benzene				0.0021	LB	E6FT3	7; Table 1.4-3
2103006000	75070	Acetaldehyde				0.00001365	LB	E6FT3	2002 NEI Documentation
2103006000	85018	Phenanthrene				1.70E-05	LB	E6FT3	7; Table 1.4-3
2103006000	86737	Fluorene				2.80E-06	LB	E6FT3	7; Table 1.4-3
2103006000	91203	Naphthalene				6.10E-04	LB	E6FT3	7; Table 1.4-3
2103006000	129000	Pyrene				5.00E-06	LB	E6FT3	7; Table 1.4-3
2103006000	206440	Fluoranthene				3.00E-06	LB	E6FT3	7; Table 1.4-3
2103006000	7439921	Lead				0.0005	LB	E6FT3	7; Table 1.4-2
2103006000	CO	Carbon Monoxide				84	LB	E6FT3	8
2103006000	NH3	Ammonia				0.49	LB	E6FT3	8
2103006000	NOX	Nitrogen Oxides				100	LB	E6FT3	8
2103006000	PM10-FIL	PM10 Filterable				0.2	LB	E6FT3	8
2103006000	PM10-PRI	PM10 Primary (Filt + Cond)				0.52	LB	E6FT3	8
2103006000	PM25-FIL	PM2.5 Filterable				0.11	LB	E6FT3	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103006000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.43	LB	E6FT3	8
2103006000	PM-CON	PM Condensible				0.32	LB	E6FT3	8
2103006000	SO2	Sulfur Dioxide				0.6	LB	E6FT3	8
2103006000	VOC	Volatile Organic Compounds				5.5	LB	E6FT3	8
2103007000	50000	Formaldehyde	0.2877	LB	E3BBL	0.00684975	LB	E3GAL	2002 NEI Documentation
2103007000	71432	Benzene	0.007672	LB	E3BBL	0.00018266	LB	E3GAL	2002 NEI Documentation
2103007000	75070	Acetaldehyde	4.99E-05	LB	E3BBL	1.18729E-06	LB	E3GAL	2002 NEI Documentation
2103007000	85018	Phenanthrene	6.52E-06	LB	E3BBL	1.55261E-06	LB	E3GAL	2002 NEI Documentation
2103007000	86737	Fluorene	1.07E-05	LB	E3BBL	2.55724E-07	LB	E3GAL	2002 NEI Documentation
2103007000	91203	Naphthalene	0.0023399	LB	E3BBL	5.57113E-05	LB	E3GAL	2002 NEI Documentation
2103007000	129000	Pyrene	1.92E-05	LB	E3BBL	4.5665E-07	LB	E3GAL	2002 NEI Documentation
2103007000	206440	Fluoranthene	1.15E-05	LB	E3BBL	2.7399E-07	LB	E3GAL	2002 NEI Documentation
2103007000	7439921	Lead	0.0018266	LB	E3BBL	4.34905E-05	LB	E3GAL	2002 NEI Documentation
2103007000	CO	Carbon Monoxide				7.97	LB	E3GAL	8
2103007000	NH3	Ammonia				0.05	LB	E3GAL	8
2103007000	NOX	Nitrogen Oxides				14.23	LB	E3GAL	8
2103007000	PM10-FIL	PM10 Filterable				0.02	LB	E3GAL	8
2103007000	PM10-PRI	PM10 Primary (Filt + Cond)				0.05	LB	E3GAL	8
2103007000	PM25-FIL	PM2.5 Filterable				0.01	LB	E3GAL	8
2103007000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.04	LB	E3GAL	8
2103007000	PM-CON	PM Condensible				0.03	LB	E3GAL	8

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103007000	SO2	Sulfur Dioxide				0.06	LB	E3GAL	8
2103007000	VOC	Volatile Organic Compounds				0.52	LB	E3GAL	8
2103008000	50000	Formaldehyde				0.00144053	LB	E6BTU	11
2103008000	71432	Benzene				0.000473582	LB	E6BTU	11
2103008000	75070	Acetaldehyde				0.002107007	LB	E6BTU	11
2103008000	83329	Acenaphthene				2.49774E-06	LB	E6BTU	11
2103008000	85018	Phenanthrene				1.94131E-05	LB	E6BTU	11
2103008000	86737	Fluorene				5.49009E-06	LB	E6BTU	11
2103008000	90120	1-Methylnaphthalene				1.3107E-05	LB	E6BTU	11
2103008000	91203	Naphthalene				0.000280687	LB	E6BTU	11
2103008000	91576	2-Methylnaphthalene				1.85476E-05	LB	E6BTU	11
2103008000	98862	Acetophenone				4.82237E-06	LB	E6BTU	11
2103008000	100414	Ethyl Benzene				2.8316E-05	LB	E6BTU	11
2103008000	106990	1,3-Butadiene				0.000144671	LB	E6BTU	11
2103008000	107028	Acrolein				7.78999E-05	LB	E6BTU	11
2103008000	108883	Toluene				0.000195368	LB	E6BTU	11
2103008000	108952	Phenol				0.000649166	LB	E6BTU	11
2103008000	120127	Anthracene				4.25358E-06	LB	E6BTU	11
2103008000	120809	Catechol				0.00038579	LB	E6BTU	11
2103008000	123319	Hydroquinone				2.12679E-05	LB	E6BTU	11
2103008000	123386	Propionaldehyde				0.000315309	LB	E6BTU	11
2103008000	129000	Pyrene				2.31227E-06	LB	E6BTU	11
2103008000	203123	Benzo(g,h,i)Fluoranthene				1.01394E-07	LB	E6BTU	11
2103008000	206440	Fluoranthene				3.77134E-06	LB	E6BTU	11
2103008000	208968	Acenaphthylene				2.2999E-05	LB	E6BTU	11
2103008000	832699	1-Methylphenanthrene				2.74504E-06	LB	E6BTU	11
2103008000	1319773	Cresol/Cresylic Acid (Mixed Isomers)				0.000580663	LB	E6BTU	11
2103008000	1330207	Xylenes (Mixed Isomers)				9.65711E-05	LB	E6BTU	11

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103008000	CO	Carbon Monoxide				0.6	LB	E6BTU	7; Section 1.6
2103008000	NH3	Ammonia				0.005	LB	E6BTU	10
2103008000	NOX	Nitrogen Oxides				0.22	LB	E6BTU	7; Section 1.6
2103008000	PM10-FIL	PM10 Filterable				0.5	LB	E6BTU	7; Section 1.6
2103008000	PM10-PRI	PM10 Primary (Filt + Cond)				0.517	LB	E6BTU	7; Section 1.6
2103008000	PM25-FIL	PM2.5 Filterable				0.43	LB	E6BTU	7; Section 1.6
2103008000	PM25-PRI	PM2.5 Primary (Filt + Cond)				0.447	LB	E6BTU	7; Section 1.6
2103008000	PM-CON	PM Condensible				0.017	LB	E6BTU	7; Section 1.6
2103008000	SO2	Sulfur Dioxide				0.025	LB	E6BTU	7; Section 1.6
2103008000	VOC	Volatile Organic Compounds				0.017	LB	E6BTU	7; Section 1.6
2103011000	50000	Formaldehyde				0.0324	LB	E3GAL	7; Table 1.3-9
2103011000	53703	Dibenzo[a,h]Anthracene				0.00000162	LB	E3GAL	7; Table 1.3-9
2103011000	56553	Benz[a]Anthracene				0.000003915	LB	E3GAL	7; Table 1.3-9
2103011000	71432	Benzene				0.0002025	LB	E3GAL	7; Table 1.3-9
2103011000	75070	Acetaldehyde				0.004725	LB	E3GAL	2002 NEI Documentation
2103011000	83329	Acenaphthene				0.00002025	LB	E3GAL	7; Table 1.3-9
2103011000	85018	Phenanthrene				0.000010125	LB	E3GAL	7; Table 1.3-9
2103011000	86737	Fluorene				0.00000432	LB	E3GAL	7; Table 1.3-9
2103011000	91203	Naphthalene				0.0010935	LB	E3GAL	7; Table 1.3-9
2103011000	120127	Anthracene				1.1745E-06	LB	E3GAL	7; Table 1.3-9
2103011000	129000	Pyrene				0.00000405	LB	E3GAL	7; Table 1.3-9
2103011000	191242	Benzo[g,h,i,]Perylene				0.00000216	LB	E3GAL	7; Table 1.3-9
2103011000	193395	Indeno[1,2,3-c,d]Pyrene				0.000002025	LB	E3GAL	7; Table 1.3-9
2103011000	206440	Fluoranthene				0.000004725	LB	E3GAL	7; Table 1.3-9
2103011000	208968	Acenaphthylene				0.000000243	LB	E3GAL	7; Table 1.3-9

SCC	Pollutant Code	Name	Original Factor Numeric Value	Original Unit Numerator	Original Denominator	Factor Numeric Value	Factor Unit Numerator	Factor Unit Denominator	Reference
2103011000	218019	Chrysene				0.000002295	LB	E3GAL	7; Table 1.3-9
2103011000	7439921	Lead				0.001215	LB	E3GAL	7; Table 1.3-11
2103011000	56832736	Benzofluoranthenes				0.000001485	LB	E3GAL	7; Table 1.3-9
2103011000	CO	Carbon Monoxide				5	LB	E3GAL	7; Table 1.3-1
2103011000	NH3	Ammonia				0.8	LB	E3GAL	10
2103011000	NOX	Nitrogen Oxides				20	LB	E3GAL	7; Table 1.3-1
2103011000	PM10-FIL	PM10 Filterable				1.08	LB	E3GAL	7; Table 1.3-7
2103011000	PM10-PRI	PM10 Primary (Filt + Cond)				2.34	LB	E3GAL	Sum of PM10-FIL and PM-CON
2103011000	PM25-FIL	PM2.5 Filterable				0.83	LB	E3GAL	7; Table 1.3-7
2103011000	PM25-PRI	PM2.5 Primary (Filt + Cond)				2.1	LB	E3GAL	Sum of PM25-FIL and PM-CON
2103011000	PM-CON	PM Condensable				1.3	LB	E3GAL	7; Table 1.3-2
2103011000	SO2	Sulfur Dioxide				142S	LB	E3GAL	7; Table 1.3-1
2103011000	VOC	Volatile Organic Compounds				0.34	LB	E3GAL	7; Table 1.3-3

**Table 6. Mapping of NAICS code to ICI sector**

NAICS	Sector
11	Industrial
21	Industrial
2212	Commercial
2213	Commercial
23	Industrial
31	Industrial
32	Industrial
33	Industrial
42	Commercial
44	Commercial
45	Commercial
48 (except 4862)	Commercial
49	Commercial
51	Commercial
52	Commercial
53	Commercial
54	Commercial
55	Commercial
56	Commercial
61	Commercial
62	Commercial
71	Commercial
72	Commercial
81	Commercial
92	Commercial

**Table 7. Mapping of point source SCCs to ICI fuel**

<b>Fuel</b>	<b>SCC</b>	<b>Description</b>
Coal	10100101	External Combustion Boilers; Electric Generation; Anthracite Coal, Pulverized; Boiler
Coal	10100102	External Combustion Boilers; Electric Generation; Anthracite Coal; Boiler, Traveling Grate (Overfeed) Stoker
Coal	10100201	External Combustion Boilers; Electric Generation; Bituminous Coal, Pulverized; Boiler, Wet Bottom
Coal	10100202	External Combustion Boilers; Electric Generation; Bituminous Coal, Pulverized; Boiler, Dry Bottom
Coal	10100203	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Cyclone Furnace
Coal	10100204	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Spreader Stoker
Coal	10100205	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Traveling Grate (Overfeed) Stoker
Coal	10100211	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Wet Bottom Tangential-fired
Coal	10100212	External Combustion Boilers; Electric Generation; Bituminous Coal, Pulverized; Boiler, Dry Bottom Tangential-fired
Coal	10100215	External Combustion Boilers; Electric Generation; Bituminous Coal; Cell Burner
Coal	10100217	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Atmospheric Fluidized Bed Combustion: Bubbling Bed
Coal	10100218	External Combustion Boilers; Electric Generation; Bituminous Coal; Boiler, Atmospheric Fluidized Bed Combustion: Circulating Bed
Coal	10100221	External Combustion Boilers; Electric Generation; Subbituminous Coal, Pulverized; Boiler, Wet Bottom
Coal	10100222	External Combustion Boilers; Electric Generation; Subbituminous Coal, Pulverized; Boiler, Dry Bottom
Coal	10100223	External Combustion Boilers; Electric Generation; Subbituminous Coal; Cyclone Furnace
Coal	10100224	External Combustion Boilers; Electric Generation; Subbituminous Coal; Boiler, Spreader Stoker
Coal	10100225	External Combustion Boilers; Electric Generation; Subbituminous Coal; Boiler, Traveling Grate (Overfeed) Stoker
Coal	10100226	External Combustion Boilers; Electric Generation; Subbituminous Coal, Pulverized; Boiler, Dry Bottom Tangential-fired
Coal	10100235	External Combustion Boilers; Electric Generation; Subbituminous Coal; Cell Burner
Coal	10100237	External Combustion Boilers; Electric Generation; Subbituminous Coal; Boiler, Atmospheric Fluidized Bed Combustion: Bubbling Bed
Coal	10100238	External Combustion Boilers; Electric Generation; Subbituminous Coal; Boiler, Atmospheric Fluidized Bed Combustion: Circulating Bed
Coal	10100300	External Combustion Boilers; Electric Generation; Pulverized Lignite; Boiler, Wet Bottom
Coal	10100301	External Combustion Boilers; Electric Generation; Pulverized Lignite; Boiler, Dry Bottom Wall-fired
Coal	10100302	External Combustion Boilers; Electric Generation; Pulverized Lignite; Boiler, Dry Bottom Tangential-fired
Coal	10100303	External Combustion Boilers; Electric Generation; Lignite; Cyclone Furnace
Coal	10100304	External Combustion Boilers; Electric Generation; Lignite; Boiler, Traveling Grate (Overfeed) Stoker
Coal	10100306	External Combustion Boilers; Electric Generation; Lignite; Boiler, Spreader Stoker
Coal	10100317	External Combustion Boilers; Electric Generation; Lignite; Boiler, Atmospheric Fluidized Bed Combustion: Bubbling Bed
Coal	10100318	External Combustion Boilers; Electric Generation; Lignite; Boiler, Atmospheric Fluidized Bed Combustion: Circulating Bed

Fuel	SCC	Description
Residual Oil	10100401	External Combustion Boilers; Electric Generation; Residual Oil - Grade 6; Boiler, Normal Firing
Residual Oil	10100404	External Combustion Boilers; Electric Generation; Residual Oil - Grade 6; Boiler, Tangential-fired
Residual Oil	10100405	External Combustion Boilers; Electric Generation; Residual Oil; Grade 5 Oil: Normal Firing
Residual Oil	10100406	External Combustion Boilers; Electric Generation; Residual Oil; Grade 5 Oil: Tangential Firing
Distillate Oil	10100501	External Combustion Boilers; Electric Generation; Distillate Oil - Grades 1 and 2; Boiler
Distillate Oil	10100504	External Combustion Boilers; Electric Generation; Distillate Oil - Grade 4; Boiler, Normal Firing
Distillate Oil	10100505	External Combustion Boilers; Electric Generation; Distillate Oil - Grade 4; Boiler, Tangential-fired
Natural Gas	10100601	External Combustion Boilers; Electric Generation; Natural Gas; Boiler, >= 100 Million BTU/hr
Natural Gas	10100602	External Combustion Boilers; Electric Generation; Natural Gas; Boiler < 100 Million BTU, except tangential
Natural Gas	10100604	External Combustion Boilers; Electric Generation; Natural Gas; Boiler, Tangential-fired
Wood	10100901	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Bark-fired Boiler
Wood	10100902	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Wood/Bark-Fired Boiler
Wood	10100903	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Wood-fired Boiler - Wet Wood (>=20% moisture)
Wood	10100908	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Wood-fired Boiler - Dry Wood (<20% moisture)
Wood	10100910	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Fuel cell/Dutch oven boilers
Wood	10100911	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Stoker boilers
Wood	10100912	External Combustion Boilers; Electric Generation; Wood/Bark Waste; Fluidized bed combustion boiler
LPG	10101001	External Combustion Boilers; Electric Generation; Liquified Petroleum Gas (LPG); Butane
LPG	10101002	External Combustion Boilers; Electric Generation; Liquified Petroleum Gas (LPG); Propane
LPG	10101003	External Combustion Boilers; Electric Generation; Liquified Petroleum Gas (LPG); Butane/Propane Mixture: Specify Percent Butane in Comments
Wood	10101207	External Combustion Boilers; Electric Generation; Biomass Solids; Biomass Solids, Boiler type unknown (use 10101209 or -10)
Wood	10101209	External Combustion Boilers; Electric Generation; Biomass Solids; Boiler, Stoker
Wood	10101210	External Combustion Boilers; Electric Generation; Biomass Solids; Boiler, Non-stoker
Residual Oil	10101302	External Combustion Boilers; Electric Generation; Liquid Waste; Waste Oil
Wood	10101304	External Combustion Boilers; Electric Generation; Liquid Waste; Black Liquor
Wood	10101305	External Combustion Boilers; Electric Generation; Liquid Waste; Red Liquor
Wood	10101306	External Combustion Boilers; Electric Generation; Liquid Waste; Spent Sulfite Liquor
Wood	10101307	External Combustion Boilers; Electric Generation; Liquid Waste; Tall Oil
Wood	10101308	External Combustion Boilers; Electric Generation; Liquid Waste; Wood/Wood Waste Liquid
Wood	10101309	External Combustion Boilers; Electric Generation; Biomass Liquids; Boiler
Coal	10101901	External Combustion Boilers; Electric Generation; Coal-based Synfuel; All

Fuel	SCC	Description
Coal	10102001	External Combustion Boilers; Electric Generation; Waste Coal; All
Coal	10102018	External Combustion Boilers; Electric Generation; Waste Coal; Circulating Fluidized Bed Combustion
Residual Oil	10102101	External Combustion Boilers; Electric Generation; Other Oil; All
Coal	10200101	External Combustion Boilers; Industrial; Anthracite Coal; Pulverized Coal
Coal	10200104	External Combustion Boilers; Industrial; Anthracite Coal; Traveling Grate (Overfeed) Stoker
Coal	10200107	External Combustion Boilers; Industrial; Anthracite Coal; Hand-fired
Coal	10200117	External Combustion Boilers; Industrial; Anthracite Coal; Fluidized Bed Boiler Burning Anthracite-Culm Fuel
Coal	10200201	External Combustion Boilers; Industrial; Bituminous Coal; Pulverized Coal: Wet Bottom
Coal	10200202	External Combustion Boilers; Industrial; Bituminous Coal; Pulverized Coal: Dry Bottom
Coal	10200203	External Combustion Boilers; Industrial; Bituminous Coal; Cyclone Furnace
Coal	10200204	External Combustion Boilers; Industrial; Bituminous Coal; Spreader Stoker
Coal	10200205	External Combustion Boilers; Industrial; Bituminous Coal; Overfeed Stoker
Coal	10200206	External Combustion Boilers; Industrial; Bituminous Coal; Underfeed Stoker
Coal	10200212	External Combustion Boilers; Industrial; Bituminous Coal; Pulverized Coal: Dry Bottom (Tangential)
Coal	10200213	External Combustion Boilers; Industrial; Bituminous Coal; Wet Slurry
Coal	10200217	External Combustion Boilers; Industrial; Bituminous Coal; Atmospheric Fluidized Bed Combustion: Bubbling Bed
Coal	10200218	External Combustion Boilers; Industrial; Bituminous Coal; Atmospheric Fluidized Bed Combustion: Circulating Bed
Coal	10200219	External Combustion Boilers; Industrial; Bituminous Coal; Cogeneration
Coal	10200221	External Combustion Boilers; Industrial; Subbituminous Coal; Pulverized Coal: Wet Bottom
Coal	10200222	External Combustion Boilers; Industrial; Subbituminous Coal; Pulverized Coal: Dry Bottom
Coal	10200223	External Combustion Boilers; Industrial; Subbituminous Coal; Cyclone Furnace
Coal	10200224	External Combustion Boilers; Industrial; Subbituminous Coal; Spreader Stoker
Coal	10200225	External Combustion Boilers; Industrial; Subbituminous Coal; Traveling Grate (Overfeed) Stoker
Coal	10200226	External Combustion Boilers; Industrial; Subbituminous Coal; Pulverized Coal: Dry Bottom (Tangential)
Coal	10200229	External Combustion Boilers; Industrial; Subbituminous Coal; Cogeneration
Coal	10200300	External Combustion Boilers; Industrial; Lignite; Pulverized Coal: Wet Bottom
Coal	10200301	External Combustion Boilers; Industrial; Lignite; Pulverized Coal: Dry Bottom, Wall Fired
Coal	10200302	External Combustion Boilers; Industrial; Lignite; Pulverized Coal: Dry Bottom, Tangential Fired
Coal	10200303	External Combustion Boilers; Industrial; Lignite; Cyclone Furnace
Coal	10200304	External Combustion Boilers; Industrial; Lignite; Traveling Grate (Overfeed) Stoker
Coal	10200306	External Combustion Boilers; Industrial; Lignite; Spreader Stoker

Fuel	SCC	Description
Coal	10200307	External Combustion Boilers; Industrial; Lignite; Cogeneration
Residual Oil	10200401	External Combustion Boilers; Industrial; Residual Oil; Grade 6 oil
Residual Oil	10200402	External Combustion Boilers; Industrial; Residual Oil; 10-100 Million BTU/hr
Residual Oil	10200403	External Combustion Boilers; Industrial; Residual Oil; < 10 Million BTU/hr
Residual Oil	10200404	External Combustion Boilers; Industrial; Residual Oil; Grade 5 Oil
Residual Oil	10200405	External Combustion Boilers; Industrial; Residual Oil; Cogeneration
Residual Oil	10200406	External Combustion Boilers; Industrial; Residual Oil; Boiler > 100 Million BTU/hr
Distillate Oil	10200501	External Combustion Boilers; Industrial; Distillate Oil - Grades 1 and 2; Boiler
Distillate Oil	10200502	External Combustion Boilers; Industrial; Distillate Oil; 10-100 Million BTU/hr
Distillate Oil	10200503	External Combustion Boilers; Industrial; Distillate Oil; < 10 Million BTU/hr
Distillate Oil	10200504	External Combustion Boilers; Industrial; Distillate Oil; Grade 4 Oil
Distillate Oil	10200505	External Combustion Boilers; Industrial; Distillate Oil; Cogeneration
Distillate Oil	10200506	External Combustion Boilers; Industrial; Distillate Oil; Boiler > 100 Million BTU/hr
Natural Gas	10200601	External Combustion Boilers; Industrial; Natural Gas; > 100 Million BTU/hr
Natural Gas	10200602	External Combustion Boilers; Industrial; Natural Gas; 10-100 Million BTU/hr
Natural Gas	10200603	External Combustion Boilers; Industrial; Natural Gas; < 10 Million BTU/hr
Natural Gas	10200604	External Combustion Boilers; Industrial; Natural Gas; Cogeneration
Wood	10200901	External Combustion Boilers; Industrial; Wood/Bark Waste; Bark-fired Boiler
Wood	10200902	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood/Bark-fired Boiler
Wood	10200903	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood-fired Boiler - Wet Wood (>=20% moisture)
Wood	10200904	External Combustion Boilers; Industrial; Wood/Bark Waste; Bark-fired Boiler (< 50,000 Lb Steam)
Wood	10200905	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood/Bark-fired Boiler (< 50,000 Lb Steam)
Wood	10200906	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood-fired Boiler (< 50,000 Lb Steam)
Wood	10200907	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood Cogeneration
Wood	10200908	External Combustion Boilers; Industrial; Wood/Bark Waste; Wood-fired Boiler - Dry Wood (<20% moisture)
Wood	10200910	External Combustion Boilers; Industrial; Wood/Bark Waste; Fuel cell/Dutch oven boilers
Wood	10200911	External Combustion Boilers; Industrial; Wood/Bark Waste; Stoker boilers
Wood	10200912	External Combustion Boilers; Industrial; Wood/Bark Waste; Fluidized bed combustion boiler
LPG	10201001	External Combustion Boilers; Industrial; Liquified Petroleum Gas (LPG); Butane
LPG	10201002	External Combustion Boilers; Industrial; Liquified Petroleum Gas (LPG); Propane
LPG	10201003	External Combustion Boilers; Industrial; Liquified Petroleum Gas (LPG); Butane/Propane Mixture: Specify Percent Butane in Comments

Fuel	SCC	Description
Residual Oil	10201302	External Combustion Boilers; Industrial; Liquid Waste; Waste Oil
Natural Gas	10201401	External Combustion Boilers; Industrial; CO Boiler; Natural Gas
Distillate Oil	10201403	External Combustion Boilers; Industrial; CO Boiler; Distillate Oil
Residual Oil	10201404	External Combustion Boilers; Industrial; CO Boiler; Residual Oil
Wood	10201801	External Combustion Boilers; Industrial; Kiln-dried biomass; Boiler, Stoker
Wood	10201802	External Combustion Boilers; Industrial; Kiln-dried biomass; Boiler, Non-stoker
Wood	10201901	External Combustion Boilers; Industrial; Wood Residuals; Boiler, Stoker
Wood	10201902	External Combustion Boilers; Industrial; Wood Residuals; Boiler, non-stoker
Coal	10300101	External Combustion Boilers; Commercial/Institutional; Anthracite Coal; Pulverized Coal
Coal	10300102	External Combustion Boilers; Commercial/Institutional; Anthracite Coal; Traveling Grate (Overfeed) Stoker
Coal	10300103	External Combustion Boilers; Commercial/Institutional; Anthracite Coal; Hand-fired
Coal	10300203	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Cyclone Furnace
Coal	10300205	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Pulverized Coal: Wet Bottom
Coal	10300206	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Pulverized Coal: Dry Bottom
Coal	10300207	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Overfeed Stoker
Coal	10300208	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Underfeed Stoker
Coal	10300209	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Spreader Stoker
Coal	10300214	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Hand-fired
Coal	10300216	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Pulverized Coal: Dry Bottom (Tangential)
Coal	10300217	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Atmospheric Fluidized Bed Combustion: Bubbling Bed
Coal	10300218	External Combustion Boilers; Commercial/Institutional; Bituminous Coal; Atmospheric Fluidized Bed Combustion: Circulating Bed
Coal	10300221	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Pulverized Coal: Wet Bottom
Coal	10300222	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Pulverized Coal: Dry Bottom
Coal	10300223	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Cyclone Furnace
Coal	10300224	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Spreader Stoker
Coal	10300225	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Traveling Grate (Overfeed) Stoker
Coal	10300226	External Combustion Boilers; Commercial/Institutional; Subbituminous Coal; Pulverized Coal: Dry Bottom (Tangential)
Coal	10300300	External Combustion Boilers; Commercial/Institutional; Lignite; Pulverized Coal: Wet Bottom
Coal	10300305	External Combustion Boilers; Commercial/Institutional; Lignite; Pulverized Coal: Dry Bottom, Wall Fired
Coal	10300306	External Combustion Boilers; Commercial/Institutional; Lignite; Pulverized Coal: Dry Bottom, Tangential Fired
Coal	10300307	External Combustion Boilers; Commercial/Institutional; Lignite; Traveling Grate (Overfeed) Stoker

Fuel	SCC	Description
Coal	10300309	External Combustion Boilers; Commercial/Institutional; Lignite; Spreader Stoker
Residual Oil	10300401	External Combustion Boilers; Commercial/Institutional; Residual Oil - Grade 6; Boiler
Residual Oil	10300402	External Combustion Boilers; Commercial/Institutional; Residual Oil; 10-100 Million BTU/hr
Residual Oil	10300403	External Combustion Boilers; Commercial/Institutional; Residual Oil; < 10 Million BTU/hr
Residual Oil	10300404	External Combustion Boilers; Commercial/Institutional; Residual Oil; Grade 5 Oil
Residual Oil	10300405	External Combustion Boilers; Commercial/Institutional; Residual Oil; Boiler > 100 Million BTU/hr
Distillate Oil	10300501	External Combustion Boilers; Commercial/Institutional; Distillate Oil - Grades 1 and 2; Boiler
Distillate Oil	10300502	External Combustion Boilers; Commercial/Institutional; Distillate Oil; 10-100 Million BTU/hr
Distillate Oil	10300503	External Combustion Boilers; Commercial/Institutional; Distillate Oil; < 10 Million BTU/hr
Distillate Oil	10300504	External Combustion Boilers; Commercial/Institutional; Distillate Oil; Grade 4 Oil
Distillate Oil	10300505	External Combustion Boilers; Commercial/Institutional; Distillate Oil; Boiler > 100 Million BTU/hr
Natural Gas	10300601	External Combustion Boilers; Commercial/Institutional; Natural Gas; > 100 Million BTU/hr
Natural Gas	10300602	External Combustion Boilers; Commercial/Institutional; Natural Gas; 10-100 Million BTU/hr
Natural Gas	10300603	External Combustion Boilers; Commercial/Institutional; Natural Gas; < 10 Million BTU/hr
Wood	10300901	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Bark-fired Boiler
Wood	10300902	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Wood/Bark-fired Boiler
Wood	10300903	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Wood-fired Boiler - Wet Wood (>=20% moisture)
Wood	10300908	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Wood-fired Boiler - Dry Wood (<20% moisture)
Wood	10300910	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Fuel cell/Dutch oven boilers
Wood	10300911	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Stoker boilers
Wood	10300912	External Combustion Boilers; Commercial/Institutional; Wood/Bark Waste; Fluidized bed combustion boiler
LPG	10301001	External Combustion Boilers; Commercial/Institutional; Liquified Petroleum Gas (LPG); Butane
LPG	10301002	External Combustion Boilers; Commercial/Institutional; Liquified Petroleum Gas (LPG); Propane
LPG	10301003	External Combustion Boilers; Commercial/Institutional; Liquified Petroleum Gas (LPG); Butane/Propane Mixture: Specify Percent Butane in Comments
Wood	10301101	External Combustion Boilers; Commercial/Institutional; Biomass; Boiler, Stoker
Wood	10301102	External Combustion Boilers; Commercial/Institutional; Biomass; Boiler, Non-stoker
Residual Oil	10301302	External Combustion Boilers; Commercial/Institutional; Liquid Waste; Waste Oil
Distillate Oil	10500105	External Combustion; Space Heaters; Industrial; Distillate Oil
Natural Gas	10500106	External Combustion; Space Heaters; Industrial; Natural Gas
LPG	10500110	External Combustion; Space Heaters; Industrial; Liquified Petroleum Gas (LPG)
Residual Oil	10500113	External Combustion; Space Heaters; Industrial; Waste Oil: Air Atomized Burner

Fuel	SCC	Description
Residual Oil	10500114	External Combustion; Space Heaters; Industrial; Waste Oil: Vaporizing Burner
Distillate Oil	10500205	External Combustion; Space Heaters; Commercial/Institutional; Distillate Oil
Natural Gas	10500206	External Combustion; Space Heaters; Commercial/Institutional; Natural Gas
Wood	10500209	External Combustion; Space Heaters; Commercial/Institutional; Wood
LPG	10500210	External Combustion; Space Heaters; Commercial/Institutional; Liquified Petroleum Gas (LPG)
Residual Oil	10500213	External Combustion; Space Heaters; Commercial/Institutional; Waste Oil: Air Atomized Burner
Residual Oil	10500214	External Combustion; Space Heaters; Commercial/Institutional; Waste Oil: Vaporizing Burner
Distillate Oil	20100101	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Turbine
Distillate Oil	20100102	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Reciprocating
Distillate Oil	20100105	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Reciprocating: Crankcase Blowby
Distillate Oil	20100106	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20100107	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Reciprocating: Exhaust
Distillate Oil	20100108	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20100109	Internal Combustion Engines; Electric Generation; Distillate Oil (Diesel); Turbine: Exhaust
Natural Gas	20100201	Internal Combustion Engines; Electric Generation; Natural Gas; Turbine
Natural Gas	20100202	Internal Combustion Engines; Electric Generation; Natural Gas; Reciprocating
Natural Gas	20100205	Internal Combustion Engines; Electric Generation; Natural Gas; Reciprocating: Crankcase Blowby
Natural Gas	20100206	Internal Combustion Engines; Electric Generation; Natural Gas; Reciprocating: Evaporative Losses (Fuel Delivery System)
Natural Gas	20100207	Internal Combustion Engines; Electric Generation; Natural Gas; Reciprocating: Exhaust
Natural Gas	20100208	Internal Combustion Engines; Electric Generation; Natural Gas; Turbine: Evaporative Losses (Fuel Delivery System)
Natural Gas	20100209	Internal Combustion Engines; Electric Generation; Natural Gas; Turbine: Exhaust
Coal	20100301	Internal Combustion Engines; Electric Generation; Gasified Coal; Turbine
Kerosene	20100901	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Turbine
Kerosene	20100902	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Reciprocating
Kerosene	20100905	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Reciprocating: Crankcase Blowby
Kerosene	20100906	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Reciprocating: Evaporative Losses (Fuel Delivery System)
Kerosene	20100907	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Reciprocating: Exhaust
Kerosene	20100908	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Kerosene	20100909	Internal Combustion Engines; Electric Generation; Kerosene/Naphtha (Jet Fuel); Turbine: Exhaust

Fuel	SCC	Description
Residual Oil	20101302	Internal Combustion Engines; Electric Generation; Liquid Waste; Waste Oil - Turbine
Distillate Oil	20200101	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Turbine
Distillate Oil	20200102	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating
Distillate Oil	20200103	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Turbine: Cogeneration
Distillate Oil	20200104	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating: Cogeneration
Distillate Oil	20200105	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating: Crankcase Blowby
Distillate Oil	20200106	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20200107	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Reciprocating: Exhaust
Distillate Oil	20200108	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20200109	Internal Combustion Engines; Industrial; Distillate Oil (Diesel); Turbine: Exhaust
Natural Gas	20200201	Internal Combustion Engines; Industrial; Natural Gas; Turbine
Natural Gas	20200202	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating
Natural Gas	20200203	Internal Combustion Engines; Industrial; Natural Gas; Turbine: Cogeneration
Natural Gas	20200204	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating: Cogeneration
Natural Gas	20200205	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating: Crankcase Blowby
Natural Gas	20200206	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating: Evaporative Losses (Fuel Delivery System)
Natural Gas	20200207	Internal Combustion Engines; Industrial; Natural Gas; Reciprocating: Exhaust
Natural Gas	20200208	Internal Combustion Engines; Industrial; Natural Gas; Turbine: Evaporative Losses (Fuel Delivery System)
Natural Gas	20200209	Internal Combustion Engines; Industrial; Natural Gas; Turbine: Exhaust
Natural Gas	20200251	Internal Combustion Engines; Industrial; Natural Gas; 2-cycle Rich Burn
Natural Gas	20200252	Internal Combustion Engines; Industrial; Natural Gas; 2-cycle Lean Burn
Natural Gas	20200253	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Rich Burn
Natural Gas	20200254	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Lean Burn
Natural Gas	20200255	Internal Combustion Engines; Industrial; Natural Gas; 2-cycle Clean Burn
Natural Gas	20200256	Internal Combustion Engines; Industrial; Natural Gas; 4-cycle Clean Burn
Distillate Oil	20200401	Internal Combustion Engines; Industrial; Diesel; Large Bore Engine
Residual Oil	20200501	Internal Combustion Engines; Industrial; Residual/Crude Oil; Reciprocating
Residual Oil	20200505	Internal Combustion Engines; Industrial; Residual/Crude Oil; Reciprocating: Crankcase Blowby
Residual Oil	20200506	Internal Combustion Engines; Industrial; Residual/Crude Oil; Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
Residual Oil	20200507	Internal Combustion Engines; Industrial; Residual/Crude Oil; Reciprocating: Exhaust
Kerosene	20200901	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Turbine

Fuel	SCC	Description
Kerosene	20200902	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Reciprocating
Kerosene	20200905	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Reciprocating: Crankcase Blowby
Kerosene	20200906	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
Kerosene	20200907	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Reciprocating: Exhaust
Kerosene	20200908	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Kerosene	20200909	Internal Combustion Engines; Industrial; Kerosene/Naphtha (Jet Fuel); Turbine: Exhaust
LPG	20201001	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Propane: Reciprocating
LPG	20201002	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Butane: Reciprocating
LPG	20201005	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Reciprocating: Crankcase Blowby
LPG	20201006	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
LPG	20201007	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Reciprocating: Exhaust
LPG	20201008	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
LPG	20201009	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Turbine: Exhaust
LPG	20201011	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Turbine
LPG	20201012	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Reciprocating Engine
LPG	20201013	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Turbine: Cogeneration
LPG	20201014	Internal Combustion Engines; Industrial; Liquified Petroleum Gas (LPG); Reciprocating Engine: Cogeneration
Distillate Oil	20300101	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Reciprocating
Distillate Oil	20300102	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Turbine
Distillate Oil	20300105	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Reciprocating: Crankcase Blowby
Distillate Oil	20300106	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Reciprocating: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20300107	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Reciprocating: Exhaust
Distillate Oil	20300108	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Distillate Oil	20300109	Internal Combustion Engines; Commercial/Institutional; Distillate Oil (Diesel); Turbine: Exhaust
Natural Gas	20300201	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating
Natural Gas	20300202	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Turbine
Natural Gas	20300203	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Turbine: Cogeneration
Natural Gas	20300204	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating: Cogeneration

Fuel	SCC	Description
Natural Gas	20300205	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating; Crankcase Blowby
Natural Gas	20300206	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating; Evaporative Losses (Fuel Delivery System)
Natural Gas	20300207	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Reciprocating; Exhaust
Natural Gas	20300208	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Turbine; Evaporative Losses (Fuel Delivery System)
Natural Gas	20300209	Internal Combustion Engines; Commercial/Institutional; Natural Gas; Turbine; Exhaust
Distillate Oil	20300401	Internal Combustion Engines; Commercial/Institutional; Diesel; Large Bore Engine
Kerosene	20300901	Internal Combustion Engines; Commercial/Institutional; Kerosene/Naphtha (Jet Fuel); Turbine: JP-4
Kerosene	20300908	Internal Combustion Engines; Commercial/Institutional; Kerosene/Naphtha (Jet Fuel); Turbine: Evaporative Losses (Fuel Storage and Delivery System)
Kerosene	20300909	Internal Combustion Engines; Commercial/Institutional; Kerosene/Naphtha (Jet Fuel); Turbine: Exhaust
LPG	20301001	Internal Combustion Engines; Commercial/Institutional; Liquified Petroleum Gas (LPG); Propane: Reciprocating
LPG	20301002	Internal Combustion Engines; Commercial/Institutional; Liquified Petroleum Gas (LPG); Butane: Reciprocating
LPG	20301005	Internal Combustion Engines; Commercial/Institutional; Liquified Petroleum Gas (LPG); Reciprocating; Crankcase Blowby
LPG	20301006	Internal Combustion Engines; Commercial/Institutional; Liquified Petroleum Gas (LPG); Reciprocating; Evaporative Losses (Fuel Storage and Delivery System)
LPG	20301007	Internal Combustion Engines; Commercial/Institutional; Liquified Petroleum Gas (LPG); Reciprocating; Exhaust
Kerosene	20400101	Internal Combustion Engines; Engine Testing; Aircraft Engine Testing; Turbojet
Kerosene	20400102	Internal Combustion Engines; Engine Testing; Aircraft Engine Testing; Turboshaft
Kerosene	20400110	Internal Combustion Engines; Engine Testing; Aircraft Engine Testing; Jet A Fuel
Kerosene	20400111	Internal Combustion Engines; Engine Testing; Aircraft Engine Testing; JP-5 Fuel
Kerosene	20400112	Internal Combustion Engines; Engine Testing; Aircraft Engine Testing; JP-4 Fuel
Natural Gas	20400301	Internal Combustion Engines; Engine Testing; Turbine; Natural Gas
Distillate Oil	20400302	Internal Combustion Engines; Engine Testing; Turbine; Diesel/Kerosene
Distillate Oil	20400303	Internal Combustion Engines; Engine Testing; Turbine; Distillate Oil
Kerosene	20400305	Internal Combustion Engines; Engine Testing; Turbine; Kerosene/Naphtha
Distillate Oil	20400402	Internal Combustion Engines; Engine Testing; Reciprocating Engine; Diesel/Kerosene
Distillate Oil	20400403	Internal Combustion Engines; Engine Testing; Reciprocating Engine; Distillate Oil
Kerosene	20400406	Internal Combustion Engines; Engine Testing; Reciprocating Engine; Kerosene/Naphtha (Jet Fuel)
Residual Oil	20400408	Internal Combustion Engines; Engine Testing; Reciprocating Engine; Residual Oil/Crude Oil
LPG	20400409	Internal Combustion Engines; Engine Testing; Reciprocating Engine; Liquified Petroleum Gas (LPG)
Distillate Oil	27000320	Internal Combustion Engines; Off-highway Diesel Engines; Industrial Equipment; Industrial Fork Lift: Diesel
LPG	27300320	Internal Combustion Engines; Off-highway LPG-fueled Engines; Industrial Equipment; Industrial Fork Lift: Liquified Petroleum Gas (LPG)

Fuel	SCC	Description
Distillate Oil	30190001	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Process Heater: Distillate Oil (No. 2)
Residual Oil	30190002	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Process Heater: Residual Oil
Natural Gas	30190003	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Process Heater: Natural Gas
Distillate Oil	30190011	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Incinerator: Distillate Oil (No. 2)
Residual Oil	30190012	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Incinerator: Residual Oil
Natural Gas	30190013	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Incinerator: Natural Gas
Distillate Oil	30190021	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Flare: Distillate Oil (No. 2)
Residual Oil	30190022	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Flare: Residual Oil
Natural Gas	30190023	Industrial Processes; Chemical Manufacturing; Fuel Fired Equipment; Flare: Natural Gas
Coal	30200112	Industrial Processes; Food and Agriculture; Alfalfa Dehydration; Coal-fired, Triple-Pass Dryer Cyclone
Wood	30200117	Industrial Processes; Food and Agriculture; Alfalfa Dehydration; Wood-fired, Single-Pass Dryer Cyclone
Natural Gas	30200220	Industrial Processes; Food and Agriculture; Coffee Roasting; Indirect-fired Batch Roaster -Natural Gas (incl combustion emiss)
Natural Gas	30200221	Industrial Processes; Food and Agriculture; Coffee Roasting; Indirect-fired Continuous Roaster -Natural Gas (incl combustion emiss)
Natural Gas	30200224	Industrial Processes; Food and Agriculture; Coffee Roasting; Direct-fired Batch Roaster - Natural Gas
Natural Gas	30200225	Industrial Processes; Food and Agriculture; Coffee Roasting; Direct-fired Continuous Roaster - Natural Gas
Coal	30201601	Industrial Processes; Food and Agriculture; Sugar Beet Processing; Pulp Dryer : Coal-fired
Distillate Oil	30201605	Industrial Processes; Food and Agriculture; Sugar Beet Processing; Pulp Dryer : Oil-fired
Natural Gas	30201608	Industrial Processes; Food and Agriculture; Sugar Beet Processing; Pulp Dryer : Natural Gas-fired
Coal	30201684	Industrial Processes; Food and Agriculture; Sugar Beet Processing; Lime Kiln : Coal-fired
Natural Gas	30201686	Industrial Processes; Food and Agriculture; Sugar Beet Processing; Lime Kiln : Natural Gas-fired
Natural Gas	30203811	Industrial Processes; Food and Agriculture; Animal/Poultry Rendering; Blood Dryer: Natural Gas Direct Fired
Natural Gas	30205020	Industrial Processes; Food and Agriculture; Ethanol Production; Natural Gas Combustion from Dryer
Natural Gas	30205021	Industrial Processes; Food and Agriculture; Ethanol Production; Natural Gas Combustion from Thermal Oxidizer
Distillate Oil	30290001	Industrial Processes; Food and Agriculture; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30290002	Industrial Processes; Food and Agriculture; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30290003	Industrial Processes; Food and Agriculture; Fuel Fired Equipment; Natural Gas: Process Heaters
LPG	30290005	Industrial Processes; Food and Agriculture; Fuel Fired Equipment; Liquified Petroleum Gas (LPG): Process Heaters
Natural Gas	30291001	Industrial Processes; Food and Agriculture; Fuel Fired Equipment; Broiling Food: Natural Gas
Natural Gas	30302312	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Indurating Furnace: Gas Fired (see 3-03-023-51 thru -88)
Distillate Oil	30302313	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Indurating Furnace: Oil Fired (see 3-03-023-51 thru -88)
Coal	30302314	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Indurating Furnace: Coal Fired (see 3-03-023-51 thru -88)

<b>Fuel</b>	<b>SCC</b>	<b>Description</b>
Natural Gas	30302351	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Grate/Kiln, Gas-fired, Acid Pellets
Natural Gas	30302352	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Grate/Kiln, Gas-fired, Flux Pellets
Coal	30302359	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Grate/Kiln, Coal-fired, Acid Pellets
Coal	30302360	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Grate/Kiln, Coal-fired, Flux Pellets
Natural Gas	30302381	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Straight Grate, Gas-fired, Acid Pellets
Natural Gas	30302382	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Straight Grate, Gas-fired, Flux Pellets
Distillate Oil	30302383	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Straight Grate, Oil-fired, Acid Pellets
Distillate Oil	30302384	Industrial Processes; Primary Metal Production; Taconite Iron Ore Processing; Induration: Straight Grate, Oil-fired, Flux Pellets
Distillate Oil	30390001	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30390002	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30390003	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Natural Gas: Process Heaters
Distillate Oil	30390011	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Incinerators
Residual Oil	30390012	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Residual Oil: Incinerators
Natural Gas	30390013	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Natural Gas: Incinerators
Distillate Oil	30390021	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Flares
Residual Oil	30390022	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Residual Oil: Flares
Natural Gas	30390023	Industrial Processes; Primary Metal Production; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	30400406	Industrial Processes; Secondary Metal Production; Lead; Refining Kettle: Pot Furnace Heater: Distillate Oil
Natural Gas	30400407	Industrial Processes; Secondary Metal Production; Lead; Refining Kettle: Pot Furnace Heater: Natural Gas
Natural Gas	30400740	Industrial Processes; Secondary Metal Production; Steel Foundries; Reheating Furnace: Natural Gas
Distillate Oil	30490001	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30490002	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30490003	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Natural Gas: Process Heaters
Distillate Oil	30490011	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Incinerators
Residual Oil	30490012	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Residual Oil: Incinerators
Natural Gas	30490013	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Natural Gas: Incinerators
Distillate Oil	30490021	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Flares
Residual Oil	30490022	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Residual Oil: Flares
Natural Gas	30490023	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	30490031	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Distillate Oil (No. 2): Furnaces
Residual Oil	30490032	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Residual Oil: Furnaces

Fuel	SCC	Description
Natural Gas	30490033	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Natural Gas: Furnaces
LPG	30490035	Industrial Processes; Secondary Metal Production; Fuel Fired Equipment; Propane: Furnaces
Natural Gas	30500206	Industrial Processes; Mineral Products; Asphalt Concrete; Asphalt Heater: Natural Gas
Residual Oil	30500207	Industrial Processes; Mineral Products; Asphalt Concrete; Asphalt Heater: Residual Oil
Distillate Oil	30500208	Industrial Processes; Mineral Products; Asphalt Concrete; Asphalt Heater: Distillate Oil
LPG	30500209	Industrial Processes; Mineral Products; Asphalt Concrete; Asphalt Heater: LPG
Natural Gas	30500251	Industrial Processes; Mineral Products; Asphalt Concrete; Batch Mix Plant: Rotary Dryer, Natural Gas-Fired (also see -45)
Distillate Oil	30500252	Industrial Processes; Mineral Products; Asphalt Concrete; Batch Mix Plant: Rotary Dryer, Oil-Fired (also see -46)
Residual Oil	30500253	Industrial Processes; Mineral Products; Asphalt Concrete; Batch Mix Plant: Rotary Dryer, Waste/Drain/# 6 Oil-Fired (also see -47)
Natural Gas	30500255	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, Natural Gas-Fired
Natural Gas	30500256	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, Natural Gas, Parallel Flow
Natural Gas	30500257	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, Natural Gas, Counterflow
Distillate Oil	30500258	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, #2 Oil-Fired
Distillate Oil	30500259	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, #2 Oil-Fired, Parallel Flow
Distillate Oil	30500260	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer / Mixer, #2 Oil-Fired, Counterflow
Residual Oil	30500261	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Plant: Rotary Drum Dryer/Mixer, Waste/Drain/#6 Oil-Fired
Residual Oil	30500262	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Pl: Rotary Drum Dryer/Mixer, Waste/Drain/#6 Oil, Parallel Flo
Residual Oil	30500263	Industrial Processes; Mineral Products; Asphalt Concrete; Drum Mix Pl: Rotary Drum Dryer/Mixer, Waste/Drain/#6 Oil, Counterflow
Natural Gas	30500311	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Tunnel Kiln: Gas-fired
Distillate Oil	30500312	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Tunnel Kiln: Oil-fired
Coal	30500313	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Tunnel Kiln: Coal-fired
Natural Gas	30500314	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Periodic Kiln: Gas-fired
Distillate Oil	30500315	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Periodic Kiln: Oil-fired
Coal	30500316	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Periodic Kiln: Coal-fired
Wood	30500318	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Tunnel Kiln: Wood-fired
Natural Gas	30500322	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Tunnel Kiln: Gas-fired: High Sulfur Material
Natural Gas	30500332	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Other Kiln: Gas-fired
Distillate Oil	30500333	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Other Kiln: Oil Fired
Coal	30500334	Industrial Processes; Mineral Products; Brick and Structural Clay Products Manufacture; Other Kiln: Coal-Fired
Natural Gas	30500810	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Spray Dryer: Natural Gas-fired
Natural Gas	30500821	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Rotary Calciner: Natural Gas-fired

Fuel	SCC	Description
Natural Gas	30500823	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Fluidized Bed Calciner: Natural Gas-fired
Natural Gas	30500840	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Presinter Thermal Processing: Natural Gas-fired Kiln
Natural Gas	30500849	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Roller Kiln: Natural Gas-fired
Natural Gas	30500850	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Tunnel Kiln: Natural Gas-fired
Natural Gas	30500851	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Shuttle Kiln: Natural Gas-fired
Natural Gas	30500856	Industrial Processes; Mineral Products; Clay Ceramics Manufacture; Refiring: Natural Gas-fired Kiln
Coal	30501618	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Coal-fired Rotary Kiln
Natural Gas	30501619	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Gas-fired Rotary Kiln
Coal	30501620	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Coal- and Gas-fired Rotary Kiln
Coal	30501621	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Coal- and Coke-fired Rotary Kiln
Coal	30501622	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Coal-fired Rotary Preheater Kiln
Natural Gas	30501623	Industrial Processes; Mineral Products; Lime Manufacture; Calcining: Gas-fired Parallel Flow Regenerative Kiln
Natural Gas	30502720	Industrial Processes; Mineral Products; Industrial Sand and Gravel; Sand Drying: Gas- or Oil-fired Rotary or Fluidized Bed Dryer
Natural Gas	30502721	Industrial Processes; Mineral Products; Industrial Sand and Gravel; Sand Drying: Gas-fired Rotary Dryer
Distillate Oil	30502722	Industrial Processes; Mineral Products; Industrial Sand and Gravel; Sand Drying: Oil-fired Rotary Dryer
Natural Gas	30502723	Industrial Processes; Mineral Products; Industrial Sand and Gravel; Sand Drying: Gas-fired Fluidized Bed Dryer
Distillate Oil	30502724	Industrial Processes; Mineral Products; Industrial Sand and Gravel; Sand Drying: Oil-fired Fluidized Bed Dryer
Natural Gas	30505020	Industrial Processes; Mineral Products; Asphalt Processing (Blowing); Asphalt Heater: Natural Gas
Residual Oil	30505021	Industrial Processes; Mineral Products; Asphalt Processing (Blowing); Asphalt Heater: Residual Oil
Distillate Oil	30505022	Industrial Processes; Mineral Products; Asphalt Processing (Blowing); Asphalt Heater: Distillate Oil
LPG	30505023	Industrial Processes; Mineral Products; Asphalt Processing (Blowing); Asphalt Heater: LPG
Natural Gas	30508909	Industrial Processes; Mineral Products; Talc Processing; Natural Gas Fired Crude Ore Dryer
Natural Gas	30508921	Industrial Processes; Mineral Products; Talc Processing; Natural Gas-fired Rotary Dryer
Natural Gas	30508931	Industrial Processes; Mineral Products; Talc Processing; Natural Gas-fired Rotary Calciner
Natural Gas	30508971	Industrial Processes; Mineral Products; Talc Processing; Natural Gas-fired Flash Drying of Slurry after Flotation
Distillate Oil	30590001	Industrial Processes; Mineral Products; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30590002	Industrial Processes; Mineral Products; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30590003	Industrial Processes; Mineral Products; Fuel Fired Equipment; Natural Gas: Process Heaters
LPG	30590005	Industrial Processes; Mineral Products; Fuel Fired Equipment; Liquified Petroleum Gas (LPG): Process Heaters
Distillate Oil	30590011	Industrial Processes; Mineral Products; Fuel Fired Equipment; Distillate Oil (No. 2): Incinerators
Residual Oil	30590012	Industrial Processes; Mineral Products; Fuel Fired Equipment; Residual Oil: Incinerators

Fuel	SCC	Description
Natural Gas	30590013	Industrial Processes; Mineral Products; Fuel Fired Equipment; Natural Gas: Incinerators
Distillate Oil	30590021	Industrial Processes; Mineral Products; Fuel Fired Equipment; Distillate Oil (No. 2): Flares
Natural Gas	30590023	Industrial Processes; Mineral Products; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	30600101	Industrial Processes; Petroleum Industry; Process Heaters; Oil-fired
Natural Gas	30600102	Industrial Processes; Petroleum Industry; Process Heaters; Gas-fired
Distillate Oil	30600103	Industrial Processes; Petroleum Industry; Process Heaters; Oil
Natural Gas	30600104	Industrial Processes; Petroleum Industry; Process Heaters; Gas
Natural Gas	30600105	Industrial Processes; Petroleum Industry; Process Heaters; Natural Gas
LPG	30600107	Industrial Processes; Petroleum Industry; Process Heaters; Liquefied Petroleum Gas (LPG)
Residual Oil	30600111	Industrial Processes; Petroleum Industry; Process Heaters; No. 6 Oil
Natural Gas	30600203	Industrial Processes; Petroleum Industry; Catalytic Cracking Unit; Fluid Catalytic Cracking Unit with CO Boiler: Natural Gas
Distillate Oil	30600205	Industrial Processes; Petroleum Industry; Catalytic Cracking Unit; Fluid Catalytic Cracking Unit with CO Boiler: Oil
Distillate Oil	30600901	Industrial Processes; Petroleum Industry; Flares; Distillate Oil
Residual Oil	30600902	Industrial Processes; Petroleum Industry; Flares; Residual Oil
Natural Gas	30600903	Industrial Processes; Petroleum Industry; Flares; Natural Gas
LPG	30600905	Industrial Processes; Petroleum Industry; Flares; Liquefied Petroleum Gas
Distillate Oil	30609901	Industrial Processes; Petroleum Industry; Incinerators; Distillate Oil (No. 2)
Residual Oil	30609902	Industrial Processes; Petroleum Industry; Incinerators; Residual Oil
Natural Gas	30609903	Industrial Processes; Petroleum Industry; Incinerators; Natural Gas
LPG	30609905	Industrial Processes; Petroleum Industry; Incinerators; Liquefied Petroleum Gas (LPG)
Wood	30700670	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Wood-fired: <600F Inlet air, <30%MC: Hardwood
Wood	30700671	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Wood-fired: <600F Inlet air, <30%MC: Softwood
Wood	30700672	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Wood-fired: <600F Inlet air, <30%MC: Mixed Softwood/Hardwood
Natural Gas	30700673	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Natural Gas-fired: <600F Inlet air, <30%MC: Hardwood
Natural Gas	30700674	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Natural Gas-fired: <600F Inlet air, <30%MC: Softwood
Natural Gas	30700675	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Dry Rotary Dryer: Direct Natural Gas-fired: <600F Inlet air, <30%MC: Mixed Softwood/Hardwood
Wood	30700676	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Wood-fired: Hardwood

Fuel	SCC	Description
Wood	30700677	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Wood-fired: Softwood
Wood	30700678	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Wood-fired: Mixed Softwood/Hardwood
Natural Gas	30700679	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Natural Gas-fired: Hardwood
Natural Gas	30700680	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Natural Gas-fired: Softwood
Natural Gas	30700681	Industrial Processes; Pulp and Paper and Wood Products; Particleboard Manufacture; Green Rotary Dryer: Direct Natural Gas-fired: Mixed Softwood/Hardwood
Wood	30700734	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Hardwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30700735	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Hardwood Veneer Dryer: Direct Wood-fired: Cooling Section
Wood	30700736	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Softwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30700737	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Softwood Veneer Dryer: Direct Wood-fired: Cooling Section
Natural Gas	30700752	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Softwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30700753	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Softwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Natural Gas	30700754	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Hardwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30700755	Industrial Processes; Pulp and Paper and Wood Products; Plywood Operations; Hardwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Wood	30700844	Industrial Processes; Pulp and Paper and Wood Products; Sawmill Operations; Lumber Kiln: Direct-fired: Softwood: Pine Species
Wood	30700845	Industrial Processes; Pulp and Paper and Wood Products; Sawmill Operations; Lumber Kiln: Direct-fired: Softwood: Non-Pine Species
Wood	30700846	Industrial Processes; Pulp and Paper and Wood Products; Sawmill Operations; Lumber Kiln: Direct-fired: Hardwood
Wood	30700893	Industrial Processes; Pulp and Paper and Wood Products; Sawmill Operations; Log Storage: Softwood
Natural Gas	30700909	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Non-Urea Formaldeh
Natural Gas	30700910	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Non-Urea Formaldeh
Natural Gas	30700911	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Non-Urea Formaldeh
Natural Gas	30700912	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Urea Formaldehyde
Natural Gas	30700913	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Urea Formaldehyde

Fuel	SCC	Description
Natural Gas	30700914	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Blowline Blend: Urea Formaldehyde
Wood	30700915	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Non-Blowline Blend: Softwood
Wood	30700916	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Non-Blowline Blend: Hardwood
Wood	30700917	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Non-Blowline Blend: Mixed Softwood/Hardwo
Wood	30700918	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Urea Formaldehyde Res
Wood	30700919	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Urea Formaldehyde Res
Wood	30700920	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Urea Formaldehyde Res
Wood	30700924	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Urea Formaldehyde Resin:
Natural Gas	30700926	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Non-Blowline Blend: Softwood
Natural Gas	30700927	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Non-Blowline Blend: Hardwood
Natural Gas	30700928	Industrial Processes; Pulp and Paper and Wood Products; Medium Density Fiberboard (MDF) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Natural Gas-fired: Non-Blowline Blend: Mixed Softwood
Wood	30701009	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Softwood
Wood	30701010	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Hardwood
Wood	30701015	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Mixed Softwood/Hardwood
Natural Gas	30701020	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Hardwood
Natural Gas	30701021	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Softwood
Natural Gas	30701022	Industrial Processes; Pulp and Paper and Wood Products; Oriented Strandboard (OSB) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Mixed Softwood/Hardwood
Wood	30701401	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Phenol Formaldehyde R
Wood	30701402	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Phenol Formaldehyde R
Wood	30701403	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Non-Phenol Formaldehyde R

Fuel	SCC	Description
Natural Gas	30701404	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Non-Phenol Formaldehyde R
Natural Gas	30701405	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Non-Phenol Formaldehyde R
Natural Gas	30701406	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Non-Phenol Formaldehyde R
Wood	30701410	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Phenol Formaldehyde Resin
Wood	30701411	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Phenol Formaldehyde Resin
Wood	30701412	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Direct Wood-fired: Blowline Blend: Phenol Formaldehyde Resin
Natural Gas	30701413	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Phenol Formaldehyde Resin
Natural Gas	30701414	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Phenol Formaldehyde Resin
Natural Gas	30701415	Industrial Processes; Pulp and Paper and Wood Products; Hardboard (HB) Manufacture; Pressurized Refiner/Primary Tube Dryer: Natural Gas-fired: Blowline Blend: Phenol Formaldehyde Resin
Wood	30701605	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Hardwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30701606	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Hardwood Veneer Dryer: Direct Wood-fired: Cooling Section
Wood	30701607	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Softwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30701608	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Softwood Veneer Dryer: Direct Wood-fired: Cooling Section
Natural Gas	30701609	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Hardwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30701610	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Hardwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Natural Gas	30701611	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Softwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30701613	Industrial Processes; Pulp and Paper and Wood Products; Laminated Veneer Lumber (LVL) Manufacture; Softwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Wood	30701701	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Hardwood
Wood	30701702	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Softwood
Wood	30701703	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Wood-fired: Mixed Softwood/Hardwood

<b>Fuel</b>	<b>SCC</b>	<b>Description</b>
Natural Gas	30701704	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Softwood
Natural Gas	30701705	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Hardwood
Natural Gas	30701706	Industrial Processes; Pulp and Paper and Wood Products; Laminated Strand Lumber (LSL) Manufacture; Rotary Strand Dryer: Direct Natural Gas-fired: Mixed Softwood/Hardwood
Wood	30701744	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Hardwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30701745	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Hardwood Veneer Dryer: Direct Wood-fired: Cooling Section
Wood	30701746	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Softwood Veneer Dryer: Direct Wood-fired: Heated Zones
Wood	30701747	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Softwood Veneer Dryer: Direct Wood-fired: Cooling Section
Natural Gas	30701748	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Hardwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30701749	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Hardwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Natural Gas	30701750	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Softwood Veneer Dryer: Direct Natural Gas-fired: Heated Zones
Natural Gas	30701751	Industrial Processes; Pulp and Paper and Wood Products; Parallel Strand Lumber (PSL) Manufacture; Softwood Veneer Dryer: Direct Natural Gas-fired: Cooling Section
Distillate Oil	30890001	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30890002	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30890003	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Natural Gas: Process Heaters
LPG	30890004	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Liquefied Petroleum Gas (LPG): Process Heaters
Distillate Oil	30890011	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Distillate Oil (No. 2): Incinerators
Residual Oil	30890012	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Residual Oil: Incinerators
Natural Gas	30890013	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Natural Gas: Incinerators
Distillate Oil	30890021	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Distillate Oil (No. 2): Flares
Residual Oil	30890022	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Residual Oil: Flares
Natural Gas	30890023	Industrial Processes; Rubber and Miscellaneous Plastics Products; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	30990001	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Distillate Oil (No. 2): Process Heaters
Residual Oil	30990002	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Residual Oil: Process Heaters
Natural Gas	30990003	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Natural Gas: Process Heaters
Distillate Oil	30990011	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Distillate Oil (No. 2): Incinerators

Fuel	SCC	Description
Residual Oil	30990012	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Residual Oil: Incinerators
Natural Gas	30990013	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Natural Gas: Incinerators
Natural Gas	30990023	Industrial Processes; Fabricated Metal Products; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	31000401	Industrial Processes; Oil and Gas Production; Process Heaters; Distillate Oil (No. 2)
Residual Oil	31000402	Industrial Processes; Oil and Gas Production; Process Heaters; Residual Oil
Natural Gas	31000404	Industrial Processes; Oil and Gas Production; Process Heaters; Natural Gas
LPG	31000406	Industrial Processes; Oil and Gas Production; Process Heaters; Propane/Butane
Distillate Oil	31000411	Industrial Processes; Oil and Gas Production; Process Heaters; Distillate Oil (No. 2): Steam Generators
Residual Oil	31000412	Industrial Processes; Oil and Gas Production; Process Heaters; Residual Oil: Steam Generators
Natural Gas	31000414	Industrial Processes; Oil and Gas Production; Process Heaters; Natural Gas: Steam Generators
Distillate Oil	31390001	Industrial Processes; Electrical Equipment; Process Heaters; Distillate Oil (No. 2)
Residual Oil	31390002	Industrial Processes; Electrical Equipment; Process Heaters; Residual Oil
Natural Gas	31390003	Industrial Processes; Electrical Equipment; Process Heaters; Natural Gas
Coal	39000199	Industrial Processes; In-process Fuel Use; Anthracite Coal; General
Coal	39000201	Industrial Processes; In-process Fuel Use; Bituminous Coal; Cement Kiln/Dryer
Coal	39000203	Industrial Processes; In-process Fuel Use; Bituminous Coal; Lime Kiln (Bituminous)
Coal	39000288	Industrial Processes; In-process Fuel Use; Bituminous Coal; General (Subbituminous)
Coal	39000289	Industrial Processes; In-process Fuel Use; Bituminous Coal; General (Bituminous)
Coal	39000399	Industrial Processes; In-process Fuel Use; Lignite; General
Residual Oil	39000402	Industrial Processes; In-process Fuel Use; Residual Oil; Cement Kiln/Dryer
Residual Oil	39000403	Industrial Processes; In-process Fuel Use; Residual Oil; Lime Kiln
Residual Oil	39000499	Industrial Processes; In-process Fuel Use; Residual Oil; General
Distillate Oil	39000501	Industrial Processes; In-process Fuel Use; Distillate Oil; Asphalt Dryer
Distillate Oil	39000502	Industrial Processes; In-process Fuel Use; Distillate Oil; Cement Kiln/Dryer
Distillate Oil	39000503	Industrial Processes; In-process Fuel Use; Distillate Oil; Lime Kiln
Distillate Oil	39000598	Industrial Processes; In-process Fuel Use; Distillate Oil; Grade 4 Oil: General
Distillate Oil	39000599	Industrial Processes; In-process Fuel Use; Distillate Oil; General
Natural Gas	39000602	Industrial Processes; In-process Fuel Use; Natural Gas; Cement Kiln/Dryer
Natural Gas	39000603	Industrial Processes; In-process Fuel Use; Natural Gas; Lime Kiln
Natural Gas	39000605	Industrial Processes; In-process Fuel Use; Natural Gas; Metal Melting
Natural Gas	39000699	Industrial Processes; In-process Fuel Use; Natural Gas; General

Fuel	SCC	Description
Wood	39000988	Industrial Processes; In-process Fuel Use; Wood; Wood Building Products: Flatwood and others
Wood	39000989	Industrial Processes; In-process Fuel Use; Wood; General
Wood	39000999	Industrial Processes; In-process Fuel Use; Wood; General: Wood
LPG	39001088	Industrial Processes; In-process Fuel Use; Liquified Petroleum Gas; Wood Building Products: Flatwood and others
LPG	39001099	Industrial Processes; In-process Fuel Use; Liquified Petroleum Gas; General
Distillate Oil	39900501	Industrial Processes; Miscellaneous Manufacturing Industries; Process Heater/Furnace; Distillate Oil
Natural Gas	39900601	Industrial Processes; Miscellaneous Manufacturing Industries; Process Heater/Furnace; Natural Gas
LPG	39901001	Industrial Processes; Miscellaneous Manufacturing Industries; Process Heater/Furnace; LPG
Distillate Oil	39990001	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Distillate Oil (No. 2): Process Heaters
Residual Oil	39990002	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Residual Oil: Process Heaters
Natural Gas	39990003	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Natural Gas: Process Heaters
Distillate Oil	39990011	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Distillate Oil (No. 2): Incinerators
Residual Oil	39990012	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Residual Oil: Incinerators
Natural Gas	39990013	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Natural Gas: Incinerators
Distillate Oil	39990021	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Distillate Oil (No. 2): Flares
Residual Oil	39990022	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Residual Oil: Flares
Natural Gas	39990023	Industrial Processes; Miscellaneous Manufacturing Industries; Miscellaneous Manufacturing Industries; Natural Gas: Flares
Natural Gas	40201001	Chemical Evaporation; Surface Coating Operations; Coating Oven Heater; Natural Gas
Distillate Oil	40201002	Chemical Evaporation; Surface Coating Operations; Coating Oven Heater; Distillate Oil
Residual Oil	40201003	Chemical Evaporation; Surface Coating Operations; Coating Oven Heater; Residual Oil
LPG	40201004	Chemical Evaporation; Surface Coating Operations; Coating Oven Heater; Liquified Petroleum Gas (LPG)
Distillate Oil	40290011	Chemical Evaporation; Surface Coating Operations; Fuel Fired Equipment; Distillate Oil: Incinerator/Afterburner
Residual Oil	40290012	Chemical Evaporation; Surface Coating Operations; Fuel Fired Equipment; Residual Oil: Incinerator/Afterburner
Natural Gas	40290013	Chemical Evaporation; Surface Coating Operations; Fuel Fired Equipment; Natural Gas: Incinerator/Afterburner
Natural Gas	40290023	Chemical Evaporation; Surface Coating Operations; Fuel Fired Equipment; Natural Gas: Flares
Distillate Oil	49090011	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Incinerator: Distillate Oil (No. 2)
Residual Oil	49090012	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Incinerator: Residual Oil
Natural Gas	49090013	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Incinerator: Natural Gas
Distillate Oil	49090021	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Flare: Distillate Oil (No. 2)
Residual Oil	49090022	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Flare: Residual Oil

<b>Fuel</b>	<b>SCC</b>	<b>Description</b>
Natural Gas	49090023	Chemical Evaporation; Organic Solvent Evaporation; Fuel Fired Equipment; Flare: Natural Gas
Distillate Oil	50100602	Waste Disposal; Solid Waste Disposal - Government; Fire Fighting; Structure: Distillate Oil
Kerosene	50100603	Waste Disposal; Solid Waste Disposal - Government; Fire Fighting; Structure: Kerosene
Coal	50190002	Waste Disposal; Solid Waste Disposal - Government; Auxiliary Fuel/No Emissions; Coal
Distillate Oil	50190005	Waste Disposal; Solid Waste Disposal - Government; Auxiliary Fuel/No Emissions; Distillate Oil
Natural Gas	50190006	Waste Disposal; Solid Waste Disposal - Government; Auxiliary Fuel/No Emissions; Natural Gas
LPG	50190010	Waste Disposal; Solid Waste Disposal - Government; Auxiliary Fuel/No Emissions; Liquefied Petroleum Gas (LPG)
Coal	50290002	Waste Disposal; Solid Waste Disposal - Commercial/Institutional; Auxiliary Fuel/No Emissions; Coal
Distillate Oil	50290005	Waste Disposal; Solid Waste Disposal - Commercial/Institutional; Auxiliary Fuel/No Emissions; Distillate Oil
Natural Gas	50290006	Waste Disposal; Solid Waste Disposal - Commercial/Institutional; Auxiliary Fuel/No Emissions; Natural Gas
LPG	50290010	Waste Disposal; Solid Waste Disposal - Commercial/Institutional; Auxiliary Fuel/No Emissions; Liquefied Petroleum Gas (LPG)
Coal	50390002	Waste Disposal; Solid Waste Disposal - Industrial; Auxiliary Fuel/No Emissions; Coal
Distillate Oil	50390005	Waste Disposal; Solid Waste Disposal - Industrial; Auxiliary Fuel/No Emissions; Distillate Oil
Natural Gas	50390006	Waste Disposal; Solid Waste Disposal - Industrial; Auxiliary Fuel/No Emissions; Natural Gas
LPG	50390010	Waste Disposal; Solid Waste Disposal - Industrial; Auxiliary Fuel/No Emissions; Liquefied Petroleum Gas (LPG)

## LANDFILLS (MERCURY)

### A. Source Category Description

While the amount of mercury in products placed in landfills has tended to decrease in recent years, there is still a significant amount of mercury in place at landfills across the country. There are three main pathways for mercury emissions at landfills: (1) emissions from landfill gas (LFG) systems, including flare and vented systems; (2) emissions from the working face of landfills where new waste is placed; and (3) emissions from the closed, covered portions of landfills.<sup>1</sup> Emissions from LFG systems are considered point sources and are already included in the NEI. Lindberg et al. (2005) found that emissions from the closed, covered portions of landfills are negligible and are similar to background soil emission rates. Therefore, this methodology focuses on emissions from the working face of landfills. In 2014, the emissions for mercury from landfills were 492.71 pounds.

For this source category, the following SCC was assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2620030001	Waste Disposal, Treatment, and Recovery	Landfills	Municipal	Dumping/Crushing/Spreading of New Materials (working face)

### B. Overview of Calculations

The calculations for estimating the emissions from landfills involve first estimating the amount of waste each landfill receives in a year. The total amount of waste in place for each landfill in a county is available from the US EPA's Landfill Methane Outreach Program (LMOP) database. The total amount of waste in place for each landfill is divided by the number of years a landfill is operational to estimate the amount of waste a landfill receives each year. The amount of waste that a landfill receives each year is multiplied by an average emissions factor to calculate the total mercury emissions from landfills for each county. Sources of data and calculations for the amount of waste in place are discussed in section C. The process of allocating landfill waste activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from mercury for landfills is discussed in section G.

### C. Activity Data

The activity data for this source category are pulled from the US EPA's LMOP database of landfills in the United States which contains information on the total amount of waste in place, as well as the opening and closing years of the landfill and the county where the landfill is located.<sup>2</sup>

To determine the number of years each landfill has been active, the year the landfill opened is subtracted from 2017. Only landfills that are open in 2017 are included in the analysis.

$$OP_l = 2017 - O_l \quad (1)$$

Where:

$$\begin{aligned} OP_l &= \text{Total number of years of operation for each landfill } l \\ O_l &= \text{Year landfill } l \text{ opened} \end{aligned}$$

The average number of tons of waste each landfill receives is estimated by dividing the total waste in place by the number of years the landfill has been operating.

$$W_l = \frac{WP_l}{OP_l} \quad (2)$$

Where:

$W_l$  = Average tons of waste that landfill  $l$  receives per year  
 $WP_l$  = Total waste in place in landfill  $l$ , in tons  
 $OP_l$  = Total number of years of operation for landfill  $l$

Some counties have multiple landfills, so emissions within the county are summed in these instances.

$$W_c = \sum_{l=1}^n W_l \quad (3)$$

Where:

$W_c$  = Average tons of waste from  $n$  landfills in county  $c$   
 $W_l$  = Average tons of waste that landfill  $l$  receives per year

#### D. Allocation Procedure

The EPA LMOP database provides data at the county level, therefore, no allocation procedure is needed for this category.

#### E. Emission Factors

The emissions factor for mercury from landfills was developed using an average of mercury emissions factors for the working face of landfills from two different studies.<sup>1,3</sup>

Lindberg et al. (2005) measured mercury emissions from the working face of four landfills in Florida and determined an average emissions factor of 2.5 mg/ton of waste, or  $5.51 \times 10^{-6}$  lbs./ton of waste placed in a landfill annually.<sup>1</sup> Babineau et al. (2016) determined that the average mercury content of municipal solid waste (MSW) in Minnesota is 0.00175 lbs./ton\*. It is assumed that 0.1% of mercury from MSW in landfills is volatilized to the air, so the emissions factor from Babineau et al. is estimated to be  $1.75 \times 10^{-6}$  lbs./ton of waste.<sup>3</sup> These emissions factors are averaged together to yield an average emissions factor of  $3.63 \times 10^{-6}$  lbs./ton of waste.

**Table 1. Emissions Factors for Mercury from Landfills (2620030001)**

Pollutant Code	Pollutant Code	Emissions Factor	Emissions Factor Units	Emissions Factor Reference
Mercury	7439976	5.51E-06	lbs./ton	1
Mercury	7439976	1.75E-06	lbs./ton	3
Mercury	7439976	3.63E-06	lbs./ton	Average of above

#### F. Controls

There are no controls assumed for this category.

\* The average Hg content of MSW in Minnesota listed in the reference document as 0.87 parts per million (ppm). A conversion factor of 0.002 is used to convert from ppm to lbs./ton – resulting in an average Hg content of 0.00175 lbs./ton.

## G. Emissions

The total mercury emissions from landfills, in pounds, is estimated by multiplying the average tons of waste that each landfill receives per year by the average emissions factor in Table 1. The emissions are reported at the county level for the county that the landfill is located in.

$$E_{p,c} = W_c \times EF_p \quad (4)$$

Where:

- $E_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$ , in lbs.
- $W_c$  = Average tons of waste from all landfills in county  $c$
- $EF_p$  = Average emissions factor for pollutant  $p$ , in lbs./ton

## H. Point Source Subtraction

There are no point source-specific SCCs for landfills; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 2 lists sample calculations to determine the mercury emissions from landfills in New Hanover County, North Carolina. The landfill used in this calculation is the New Hanover County Secure Landfill in New Hanover County, NC. New Hanover County, NC only has one landfill, so equation 3 is only including this one value.

**Table 2. Sample calculations for mercury emissions from landfills in New Hanover County, NC**

Eq. #	Equation	Values for New Hanover County, North Carolina	Result
1	$OP_l = 2017 - O_l$	2017 – 1979	38 years that New Hanover County Secure Landfill will be open
2	$W_l = \frac{WP_l}{OP_l}$	$\frac{4,845,027 \text{ tons}}{38 \text{ years}}$	127,501 average tons of waste per year for the New Hanover County Secure Landfill
3	$W_c = \sum_c W_l$	N/A; there is only one landfill in Hanover County, NC	111,191 average tons of waste per year for the New Hanover County, NC
4	$E_{p,c} = W_c \times EF_p$	$127,501 \text{ tons} \times (3.63 \times 10^{-6}) \frac{\text{lbs.}}{\text{tons}}$	0.46 pounds of mercury for New Hanover County, NC

## **J. Changes from 2014 Methodology**

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## **K. Puerto Rico and US Virgin Islands Emissions Calculations**

Emissions from Puerto Rico and the Virgin Islands are calculated using the same methodology described above.

## **L. References**

- <sup>1</sup> Lindberg, S.E., G.R. Southworth, M.A. Bogle, T.J. Blasing, J. Owens, K. Roy, H. Zhang, T. Kuiken, J. Price, D. Reinhart, and H. Sfeir. 2005. Airborne Emission of Mercury from Municipal Solid Waste. I: New Measurements from Six Operating Landfills in Florida. *Journal of the Air and Waste Management Association*, 55: 859-869. Available at: <https://www.tandfonline.com/doi/abs/10.1080/10473289.2005.10464684>, last accessed May 2018.
- <sup>2</sup> US EPA. 2018. Landfill Methane Outreach Program. Available at: <http://www.epa.gov/lmop/>, last accessed May 2018.
- <sup>3</sup> Babineau, I., Wu, C.Y., Jackson, A., Minnesota Pollution Control Agency. "Emission Factor Development for Mercury Emitted From Municipal Solid Waste during Processing and Handling." In proceedings of the 109th Annual Meeting of the A&WMA, New Orleans, LA. June 2016.

## MINING AND QUARRYING

### A. Source Category Description

Mining and quarrying activities produce particulate matter (PM) emissions due to the variety of processes used to extract the ore and associated overburden, including drilling and blasting, loading and unloading, and overburden replacement. Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal. Each of these mining operations has specific emissions factors accounting for the different means by which the resources are extracted. In 2014, mining and quarrying in the US, Puerto Rico, and US Virgin Islands resulted in approximately 585,991 tons of PM10-PRI emissions.

For this source category the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2325000000	Industrial Processes	Mining and Quarrying: SIC 14	All Processes	Total

### B. Overview of Calculations

Four specific activities are included in the emissions estimate for mining and quarrying operations: overburden removal, drilling and blasting, loading and unloading, and overburden replacement. Not included are the transfer and conveyance operations, crushing and screening operations, and storage since the dust emissions from these activities are assumed to be well controlled. Fugitive dust emissions for mining and quarrying operations are the sum of emissions from the mining of metallic and nonmetallic ores and coal. Emissions for each activity are calculated by multiplying the emissions factors by the activity data. The sources of activity data are described in section C, the allocation procedure is described in section D, the sources of the emissions factors are described in section E, and the sources of data and emissions calculations are described in section G.

### C. Activity Data

Activity data for this source category include state-level metallic and non-metallic (a.k.a. mineral) crude ore handled at surface mines from the U.S. Geologic Survey (USGS) <sup>1</sup> and mine-specific coal production data for surface mines from the Energy Information Administration (EIA).<sup>2</sup> Emissions are not estimated for underground mining given that emissions factors are calculated exclusively for surface activity.

In some cases the amount of mining waste is withheld for some states to avoid disclosing company proprietary data. To estimate state-level withheld waste data the fraction of crude ore production in the state is multiplied by the amount of waste data withheld at the national level. The national-level amount of waste withheld is calculated by subtracting all known state-level waste values (i.e. those that are *not* withheld) from the national-level waste value. Note that this calculation only needs to be completed for states where state-level mining waste data are withheld.

$$W_s = \frac{O_s}{O_{US}} \times W_{US} \quad (1)$$

Where:

- $W_s$  = Amount of metallic and non-metallic mining waste for state  $s$ , in metric tons
- $W_{US}$  = Amount of metallic and non-metallic mining waste withheld at the national-level, in metric tons
- $O_s$  = Amount of crude ore produced in state  $s$ , in metric tons
- $O_{US}$  = Amount of crude ore produced at the national-level, in metric tons

The data on state-level mining production and waste is split into production and waste for metallic and non-metallic ores using the fraction of national-level metallic and non-metallic ore production. Values are also converted from metric tons to short tons. Throughout the remainder of this document references to “ton(s)” refer to short tons, while metric tons will be explicitly labeled.

$$MP_{t,s} = (W_s + O_s) \times \frac{MP_{t,US}}{MP_{US}} \times 1.1023 \text{ ton/metric ton} \quad (2)$$

Where:

- $MP_{t,s}$  = Amount of mining material type  $t$  (i.e. either metallic or non-metallic ore) produced in state  $s$ , in tons
- $W_s$  = Amount of total metallic and non-metallic mining waste for state  $s$ , in metric tons
- $O_s$  = Amount of crude ore produced in state  $s$ , in metric tons
- $MP_{t,US}$  = Amount of mining material type  $t$  produced at the national-level, in metric tons
- $MP_{US}$  = Total metallic and non-metallic ore production at the national-level, in metric tons

#### D. Allocation Procedure

The state-level data on metallic and non-metallic mining materials (from equation 2) is distributed to the county level based on the proportion of employees in the metallic and non-metallic ore sectors (see Table 1 for a list of NAICS codes), from the U.S. Census Bureau County Business Patterns.<sup>3</sup> Separate fractions are determined for metallic ore mining employees and non-metallic ore mining employees in each county.

$$EmpFrac_{t,c} = \frac{Emp_{t,c}}{Emp_{t,s}} \quad (3)$$

Where:

- $EmpFrac_{t,c}$  = The fraction of mining employees for material type  $t$  in county  $c$
- $Emp_{t,c}$  = The number of mining employees for material type  $t$  in county  $c$
- $Emp_{t,s}$  = The number of mining employees for material type  $t$  in state  $s$

**Table 1. NAICS Codes for Metallic and Non-Metallic Mining**

NAICS Code	Description
2122	Metal Ore Mining
212210	Iron Ore Mining
21222	Gold Ore and Silver Ore Mining
212221	Gold Ore Mining
212222	Silver Ore Mining
21223	Copper, Nickel, Lead, and Zinc Mining
212231	Lead Ore and Zinc Ore Mining
212234	Copper Ore and Nickel Ore Mining
21229	Other Metal Ore Mining
212291	Uranium-Radium-Vanadium Ore Mining
212299	All Other Metal Ore Mining
2123	Nonmetallic Mineral Mining and Quarrying
21231	Stone Mining and Quarrying
212311	Dimension Stone Mining and Quarrying
212312	Crushed and Broken Limestone Mining and Quarrying
212313	Crushed and Broken Granite Mining and Quarrying
212319	Other Crushed and Broken Stone Mining and Quarrying
21232	Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying
212321	Construction Sand and Gravel Mining
212322	Industrial Sand Mining
212324	Kaolin and Ball Clay Mining
212325	Clay and Ceramic and Refractory Minerals Mining

NAICS Code	Description
21239	Other Nonmetallic Mineral Mining and Quarrying
212391	Potash, Soda, and Borate Mineral Mining
212392	Phosphate Rock Mining
212393	Other Chemical and Fertilizer Mineral Mining
212399	All Other Nonmetallic Mineral Mining

Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code being computed.

To gap-fill withheld state-level employment data:

- State-level data for states with known employment in each NAICS are summed to the national level.
- The total sum of state-level known employment from step a is subtracted from the national total reported employment for each NAICS in the national-level CBP to determine the employment total for the withheld states.
- Each of the withheld states is assigned the midpoint of the range code reported for that state. Table 2 lists the range codes and midpoints.
- The midpoints for the states with withheld data are summed to the national-level.
- An adjustment factor is created by dividing the number of withheld employees (calculated in step b of this section) by the sum of the midpoints (step d).
- For the states with withheld employment data, the midpoint of the range for that state (step c) is multiplied by the adjustment factor (step e) to calculate the adjusted state-level employment for landfills.

These same steps are then followed to fill in withheld data in the county-level business patterns.

- County-level data for counties with known employment are summed by state.
- County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
- Each of the withheld counties is assigned the midpoint of the range code (Table 2).
- The midpoints for the counties with withheld data are summed to the state level.
- An adjustment factor is created by dividing the number of withheld employees (step h) by the sum of the midpoints (step j).
- For counties with withheld employment data, the midpoints (step i) are multiplied by the adjustment factor (step k) to calculate the adjusted county-level employment for landfills.

**Table 2. Withheld data ranges and midpoints**

Employment Code	Employment Range	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2014 CBP data for NAICS 2123 (Nonmetallic Mineral Mining and Quarrying) in Arizona provided in Table 3.

**Table 3. 2014 County Business Pattern for NAICS 2123 in Arizona**

State FIPS	County FIPS	County Name	NAICS	Employment Code	Employment
04	001	Apache	2123	B	withheld
04	003	Cochise	2123		15
04	005	Coconino	2123	A	withheld
04	007	Gila	2123	A	withheld
04	009	Graham	2123	B	withheld
04	012	La Paz	2123	A	withheld
04	013	Maricopa	2123		319
04	015	Mohave	2123		73
04	017	Navajo	2123		55
04	019	Pima	2123		121
04	021	Pinal	2123	E	withheld
04	025	Yavapai	2123		179
04	027	Yuma	2123		43

*Note:* Counties in Arizona that do not have employment in mining and quarrying are excluded from this table.

1. The total number of employees reported at the county level is 805.
2. The state-level CBP reports 1,175 employees for NAICS 2123. This means that there are 370 employees withheld at the county level.
3. The counties with withheld data are assigned midpoints according to the employment codes in Table 2. For example, County 021 is given a midpoint of 375 employees (since employment code E is 250-499).
4. The sum of the midpoints for all withheld counties is 525 employees.
5. The adjustment factor is  $370/525 = 0.7048$ .
6. The adjusted employment for county 021 is  $375 \times 0.7048 = 264$  employees.

Once county- and state-level metal and non-metal employment are known for each county, the ratio of county to state employees (from equation 3) is multiplied by the state-level metal and non-metal production (from equation 2) to calculate county-level production.

$$MP_{t,c} = MP_{t,s} \times EmpFrac_{t,c} \quad (4)$$

Where:

- $MP_{t,c}$  = Amount of mining material type  $t$  produced in county  $c$ , in tons  
 $MP_{t,s}$  = Amount of mining material type  $t$  (i.e. either metallic or non-metallic ore) produced in state  $s$ , in tons  
 $EmpFrac_{t,c}$  = The fraction of mining employees for material type  $t$  in county  $c$

## E. Emissions Factors

Emissions factors are calculated separately for metallic ore mining, non-metallic ore mining, and coal mining. This section describes those calculations and the relevant data sources.

### *Metallic Ore Mining*

The emissions factor for metallic ore mining includes emissions from overburden removal, drilling and blasting, and loading and unloading activities, and are taken from emissions factors for copper ore mining from EPA's *National Air Pollutant Emission Trends Procedures Document for 1900-1996*.<sup>4</sup> The emissions factors are applied to all three

activities with PM10/TSP ratios of 0.35 for overburden removal,<sup>5</sup> 0.81 for drilling and blasting,<sup>6</sup> and 0.43 for loading and unloading operations.<sup>6</sup>

$$EF_{PM10,m} = EF_o + (B \times EF_b) + EF_l + EF_d \quad (5)$$

Where:

- $EF_{PM10,m}$  = PM10-PRI metallic ore mining emissions factor, in lbs./ton
- $EF_o$  = PM10-PRI open pit overburden removal emissions factor for copper ore, in lbs./ton
- $B$  = Fraction of total ore production that is obtained by blasting at metallic ore mines
- $EF_b$  = PM10-PRI drilling/blasting emissions factor for copper ore, in lbs./ton
- $EF_l$  = PM10-PRI loading emissions factor for copper ore, in lbs./ton
- $EF_d$  = PM10-PRI truck dumping emissions factor for copper ore, in lbs./ton

Using values from the *National Air Pollutant Emission Trends Procedures Document for 1900-1996, Table 3.1-3*, the PM10-PRI emissions factor is calculated as:

$$0.0548 \text{ lbs./ton} = 0.0003 + (0.57625 \times 0.0008) + 0.022 + 0.032 \quad (5a)$$

The PM25-PRI emissions factor is assumed to be 12.5% of the PM10-PRI emissions factor.

$$EF_{PM25,m} = EF_{PM10,m} \times 0.125 \quad (6)$$

$$0.0069 = 0.0548 \times 0.125 \quad (6a)$$

Where:

- $EF_{PM25,m}$  = PM25-PRI metallic ore mining emissions factor, in lbs./ton
- $EF_{PM10,m}$  = PM10-PRI metallic ore mining emissions factor, in lbs./ton

### ***Non-Metallic Ore Mining***

The emissions factor for non-metallic ore mining includes overburden removal, drilling and blasting, and loading and unloading activities. The emissions factor is based on western surface coal mining operations from AP-42<sup>7</sup> and a PM10/TSP ratio.

$$EF_{PM10,nm} = EF_v + (D \times EF_r) + EF_a + (0.5 \times (EF_e + EF_t)) \quad (7)$$

Where:

- $EF_{PM10,nm}$  = PM10-PRI non-metallic ore mining emissions factor, in lbs./ton
- $EF_v$  = PM10-PRI open pit overburden removal emissions factor at western surface coal mining operations, in lbs./ton
- $D$  = fraction of total ore production that is obtained by blasting at non-metallic ore mines
- $EF_r$  = PM10-PRI drilling/blasting emissions factor at western surface coal mining operations, in lbs./ton
- $EF_a$  = PM10-PRI loading emissions factor at western surface coal mining operations, in lbs./ton
- $EF_e$  = PM10-PRI truck unloading: end dump-coal emissions factor at western surface coal mining operations, in lbs./ton
- $EF_t$  = PM10-PRI truck unloading: bottom dump-coal emissions factor at western surface coal mining operations, in lbs./ton

Applying the TSP emissions factors developed for western surface coal mining operations from AP-42<sup>7</sup> and a PM10/TSP ratio of 0.4<sup>8</sup> yields the following non-metallic ore mining emissions factor:

$$0.293 \text{ lbs./ton} = 0.225 + (0.61542 \times 0.00005) + 0.05 + 0.5 (0.0035 + 0.033) \quad (7a)$$

The PM25-PRI emissions factor is assumed to be 12.5% of the PM10-PRI emissions factor.

$$EF_{PM25,nm} = EF_{10,nm} \times 0.125 \quad (8)$$

$$0.037 \text{ lbs/ton} = 0.293 \times 0.125 \quad (8a)$$

Where:

$EF_{PM25,nm}$  = PM25-PRI non-metallic ore mining emissions factor, in lbs./ton

$EF_{PM10,nm}$  = PM10-PRI non-metallic ore mining emissions factor, in lbs./ton

### Coal Mining

The emissions factor for coal mining includes overburden removal, drilling and blasting, loading and unloading and overburden replacement activities. The amount of overburden material handled is assumed to equal ten times the quantity of coal mined and coal unloading is assumed to split evenly between end-dump and bottom-dump operations. The emissions factor is based on the PM<sub>10</sub> emissions factors developed for western surface coal mining operations from AP-42.<sup>7</sup>

$$EF_{PM10,co} = (10 \times (EF_{to} + EF_{or} + EF_{dt})) + EF_v + EF_r + EF_a + (0.5 \times (EF_e + EF_t)) \quad (9)$$

Where:

$EF_{PM10,co}$  = PM10-PRI coal mining emissions factor, in lbs./ton

$EF_{to}$  = PM10-PRI emissions factor for truck loading overburden at western surface coal mining operations, in lbs./ton of overburden

$EF_{or}$  = PM10-PRI emissions factor for overburden replacement at western surface coal mining operations, in lbs./ton of overburden

$EF_{dt}$  = PM10-PRI emissions factors for truck unloading: bottom dump-overburden at western surface coal mining operations, in lbs./ton of overburden

$EF_v$  = PM10-PRI open pit overburden removal emissions factor at western surface coal mining operations, in lbs./ton

$EF_r$  = PM10-PRI drilling/blasting emissions factor at western surface coal mining operations, in lbs./ton

$EF_a$  = PM10-PRI loading emissions factor at western surface coal mining operations, in lbs./ton

$EF_e$  = PM10-PRI truck unloading: end dump-coal emissions factor at western surface coal mining operations, in lbs./ton

$EF_t$  = PM10-PRI truck unloading: bottom dump-coal emissions factor at western surface coal mining operations, in lbs./ton

Applying the PM10-PRI emissions factors developed for western surface coal mining operations<sup>7</sup> yields the following coal mining emissions factor:

$$0.513 \text{ lbs/ton} = (10 \times (0.015 + 0.001 + 0.006)) + 0.225 + 0.00005 + 0.05 + (0.5 \times (0.0035 + 0.033)) \quad (9a)$$

The PM25-PRI emissions factor is assumed to be 12.5% of the PM10-PRI emissions factor.

$$EF_{PM25,co} = EF_{10,co} \times 0.125 \quad (10)$$

Where:

$EF_{PM25,co}$  = PM25-PRI coal mining emissions factor, in lbs./ton

$EF_{PM10,co}$  = PM10-PRI coal mining emissions factor, in lbs./ton

#### **PM-FIL and PM2.5-PRI Emissions Factors**

PM-FIL emissions factors are assumed to be the same as PM-PRI emissions factors. In reality, there is a small amount of PM-CON emissions included in the PM-PRI emissions but insufficient data exists to estimate the PM-CON portion. In 2006, the EPA adopted new PM2.5/PM10 ratios for several fugitive dust categories and concluded that the PM2.5/PM10 ratios for fugitive dust categories should be in the range of 0.1 to 0.15.<sup>9</sup> Consequently, a ratio of 0.125 was applied to the PM10 emissions factors to estimate PM2.5 emissions factors for mining and quarrying. A summary of emissions factors is presented in Table 4.

**Table 4. Emissions factors for Mining and Quarrying (2325000000)**

<b>Mining Type</b>	<b>Pollutant</b>	<b>Emissions Factor</b>	<b>Emissions Factor Units</b>	<b>Emissions Factor Reference</b>
Metallic	PM10-PRI	0.0548	lbs./ton	4
Metallic	PM10-FIL	0.0548	lbs./ton	4
Metallic	PM25-PRI	0.0069	lbs./ton	PM10 × 0.125
Metallic	PM25-FIL	0.0069	lbs./ton	PM10 × 0.125
Non-Metallic	PM10-PRI	0.293	lbs./ton	7, 8
Non-Metallic	PM10-FIL	0.293	lbs./ton	7, 8
Non-Metallic	PM25-PRI	0.037	lbs./ton	PM10 × 0.125
Non-Metallic	PM25-FIL	0.037	lbs./ton	PM10 × 0.125
Coal	PM10-PRI	0.513	lbs./ton	7
Coal	PM10-FIL	0.513	lbs./ton	7
Coal	PM25-PRI	0.064	lbs./ton	PM10 × 0.125
Coal	PM25-FIL	0.064	lbs./ton	PM10 × 0.125

#### **F. Controls**

There are no controls assumed for this category.

#### **G. Emissions**

Emissions from mining and quarrying are calculated by multiplying the amount of mining material produced (from equation 4 for metallic and non-metallic mining, and from the EIA<sup>2</sup> for coal) by an emissions factor (from Table 4).

$$E_{p,t,c} = EF_{t,p} \times MP_{t,c} \quad (11)$$

Where:

- $E_{t,p,c}$  = Annual emissions of pollutant  $p$  from mining material type  $t$  in county  $c$ , in lbs.
- $EF_{t,p}$  = Emissions factor for pollutant  $p$  from mining material type  $t$ , in lbs./ton of material produced
- $MP_{t,c}$  = Amount of mining material type  $t$  produced in county  $c$ , in tons

The final step of the process is to sum the mining emissions estimates for each pollutant in each county. Emissions estimates are then converted from pounds to tons.

$$AE_{p,c} = \sum_t E_{p,t,c} \times 0.0005 \text{ }^{ton}/\text{lb.} \quad (12)$$

Where:

- $AE_{p,c}$  = Annual emissions of pollutant  $p$  in county  $c$ , in tons
- $E_{t,p,c}$  = Annual emissions of pollutant  $p$  from mining material type  $t$  in county  $c$ , in lbs.

## H. Point Source Subtraction

There are no point source-specific SCCs for mining and quarrying; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

The steps below provide sample calculations to determine the PM25-PRI emissions from mining and quarrying operations in Barbour County, Alabama. Constant emissions factor calculations that are used in all counties are not repeated here.

Table 5 provides a summary of these calculations. Note that equations 5-10 produce constant emissions factors that are used in all counties. Those calculations are not repeated here.

**Table 5. Sample calculations for estimating PM25-PRI emissions from mining and quarrying in Barbour County, Alabama**

Eq. #	Equation	Values for Barbour County, AL	Result
1	$W_s = \frac{O_s}{O_{US}} \times W_{US}$	N/A	Waste data is not withheld for Alabama.
2	$MP_{t,s}$ $= (W_s + O_s) \times \frac{MP_{t,US}}{MP_{US}}$ $\times 1.1023 \text{ short ton/metric ton}$	$(3,720 + 42,900)$ $\times (2,660,000 \div 5,060,000)$ $\times 1.1023 \text{ ton/metric ton}$	27,015 thousand tons metallic ore in Alabama
		$(3,720 + 42,900)$ $\times (2,400,000 \div 5,060,000)$ $\times 1.1023 \text{ ton/metric ton}$	24,375 thousand tons non-metallic ore in Alabama
3	$EmpFrac_{t,c} = \frac{Emp_{t,c}}{Emp_{t,s}}$	$\frac{67 \text{ metallic mining employess in Barbour}}{67 \text{ metallic mining employees in Alabama}}$	Metallic employee fraction of 1 for Barbour County, AL
		$\frac{8 \text{ nonmetallic mining employess in Barbor}}{1,778 \text{ nonmetallic mining employess in AL}}$	Nonmetallic employee fraction of $4.5 \times 10^{-3}$ for Barbour County, AL
4	$MP_{t,c} = MP_{t,s} \times EmpFrac_{t,c}$	$27,015 \text{ tons} \times 1$	27,015 thousand tons metallic ore in Barbour County, AL
		$24,375 \text{ tons} \times 4.5 \times 10^{-3}$	112 thousand tons non-metallic ore in Barbour County, AL
11	$E_{p,t,c} = EF_{t,p} \times MP_{t,c}$	$0.0068 \text{ lbs./ton} \times 27,015,167 \text{ tons}$	184,922.19 lbs. PM25-PRI emissions from metallic ore in Barbour County, AL

Eq. #	Equation	Values for Barbour County, AL	Result
		$0.037 \text{ lbs./ton} \times 112,039 \text{ tons}$	4,107.38 lbs. PM25-PRI emissions from non-metallic ore in Barbour County, AL
		$0.064 \text{ lbs./ton} \times 0 \text{ tons}$	0 lbs. PM25-PRI from coal mining in Barbour County, AL
12	$AE_{p,c} = \sum_t E_{p,c} \times 0.0005 \text{ short ton/lb.}$	$184,922.19 \text{ lbs.} + 4,107.38 \text{ lbs.} + 0 \text{ lbs.} \times 0.0005 \text{ ton/lb.}$	95 tons PM25-PRI from mining and quarrying in Barbour County, AL

#### J. Changes from 2014 Methodology

There are no significant changes for this methodology from the methodology used for the 2014 NEI.

#### K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

#### L. References

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- <sup>2</sup> U.S. Department of Energy, Energy Information Administration. “Detailed data from the EIA-7A and the U.S. Mine Safety and Health Administration”, data pulled for year 2014,  
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- <sup>3</sup> U.S. Census Bureau. 2014 County Business Patterns, available at  
<http://www.census.gov/data/datasets/2014/econ/cbp/2014-cbp.html>
- <sup>4</sup> U.S. Environmental Protection Agency. 1998. *National Air Pollutant Emission Trends Procedure Document for 1900-1996*, EPA-454/R-98-008.
- <sup>5</sup> U.S. Environmental Protection Agency, AP-42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, Section 13.2.4: Aggregate Handling and Storage Piles  
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- <sup>6</sup> U.S. Environmental Protection Agency. 1986. *Generalized Particle Size Distributions for Use in Preparing Size-Specific Particulate Emissions Inventories*, EPA-450/4-86-013.
- <sup>7</sup> U.S. Environmental Protection Agency, AP-42, Fifth Edition, Volume 1, Chapter 11: Mineral Products Industry, Section 11.9: Western Surface Coal Mining, <http://www.epa.gov/ttn/chief/ap42/ch11/final/c11s09.pdf>.
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- <sup>9</sup> Midwest Research Institute. 2006. *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*, MRI Project No. 110397  
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## OTHER MERCURY

### A. Source Category Description

The other mercury emission categories include Switches and Relays, Fluorescent Lamp Breakage, Dental Amalgam, General Laboratory Activities, Thermostats, Thermometers, Fluorescent Lamp Recycling, and Batteries.

#### Switches and Relays

Switches and relays make up the largest potential source of mercury from products that intentionally contain mercury. Mercury is an excellent electrical conductor and is liquid at room temperature, making it useful in a variety of products, including switches used to indicate motion or tilt, as the mercury will flow when the switch is in a certain position, completing the circuit.

While mercury switches in cars were phased out as of the 2002 model year, there are still millions of cars on the road that contain them. The switches and relays in these cars are potential emissions sources when the cars are recycled at the end of their useful lives, which involves crushing and shredding of the car. The shredded material is then sent to an arc furnace to recycle the steel. To avoid double counting point source emissions from arc furnaces, this source category only includes an estimate of nonpoint emissions from crushing/shredding operations. In 2014, switches and relays in the US, Puerto Rico, and US Virgin Islands resulted in 3,296 pounds of mercury emissions.

#### Fluorescent Lamp Breakage/Recycling

Fluorescent lights are a potentially significant source of mercury emissions. Although each lamp contains only a small amount of mercury, which has been decreasing in recent years, the increased demand for fluorescent lamps could lead to increases in mercury emissions. Increased demand for fluorescent lamps, particularly compact fluorescents, is driven partly by the phase out of many types of incandescent bulbs from the Energy Independence and Security Act of 2007 (PL 110-140 § 321). In 2014, fluorescent lamp breakage in the US, Puerto Rico, and US Virgin Islands resulted in 1,779.06 pounds of mercury emissions.

In addition to emissions of mercury from the breakage of fluorescent light bulbs (SCC 2861000000), there is a small amount of emissions from recycling fluorescent bulbs (SCC 2861000010). In 2014, fluorescent lamp recycling in the US, Puerto Rico, and US Virgin Islands resulted in 0.642 pounds of mercury emissions.

#### Dental Amalgam

Dental amalgam is used to fill cavities in teeth, and it is composed of approximately 45% mercury<sup>1</sup>; however, the use of dental amalgam is declining due to the increased popularity of composite fillings for teeth.<sup>2</sup> Nevertheless, there is still a small amount of mercury emissions from dental amalgam in restored teeth. There are two potential sources of mercury emissions from dental amalgam: emissions from the preparation of amalgam in dental offices, and emissions directly from restored teeth. In 2014, dental amalgam in the US, Puerto Rico, and US Virgin Islands resulted in 922 pounds of mercury emissions.

#### General Laboratory Activities

Documentation for previous versions of the NEI have cited personal communications with USGS staff for estimates of the amount of mercury used in general laboratory activities. In discussions with Robert Virta of the USGS (2013), EPA learned that the USGS stopped conducting its survey of the end uses of mercury in the economy in 2002.<sup>3</sup> However, the Interstate Mercury Education and Reduction Clearinghouse (IMERC) tracks the use of mercury-added chemical products that are sold as a consistent mixture of chemicals.<sup>4</sup> Since this trend indicates that the use of mercury-added chemical products has remained relatively consistent since 2002, the estimate of mercury emissions from general laboratory activities in the 2008 NEI is pulled forward for the 2017 NEI.

### Thermostats/Thermometers

Mercury has been used in thermostats to switch on or off a heater or air conditioner based on the temperature of a room. Most of the historic production of mercury thermostats came from three corporations: Honeywell, White-Rogers, and General Electric. In 1998 these corporations formed the Thermostat Recycling Corporation (TRC), a voluntary program that attempts to collect and recycle mercury thermostats as they come out of service.<sup>5</sup> In 2014, thermostats in the US, Puerto Rico, and US Virgin Islands resulted in 231 pounds of mercury emissions.

Mercury thermometers have all but been phased out in the United States, with the USEPA and National Institute of Standards and Technology (NIST) working to phase out mercury thermometers in industrial and laboratory settings. NIST issued notice in 2011 that it would no longer calibrate mercury-in-glass thermometers for traceability purposes. EPA issued a rule in 2012 that provides flexibility to use alternatives to mercury thermometers when complying with certain regulations pertaining to petroleum refining, power generation, and PCB waste disposal. Furthermore, thirteen states have laws that limit the manufacture, sale, and/or distribution of mercury-containing fever thermometers.<sup>6</sup> Nevertheless, given the historical prevalence of mercury thermometers, it is likely that a significant amount of mercury remains in thermometers in homes in the United States. In 2014, thermometers in the US, Puerto Rico, and US Virgin Islands resulted in 11 pounds of mercury emissions.

### Batteries

Mercury use in batteries has decreased from a peak of 1,000 tons per year in the early 1980s to less than one ton in the mid-1990s.<sup>7,8</sup> The Mercury-Containing and Rechargeable Battery Management Act of 1996 (P.L. 104-142) phased out the use of most types of mercury containing batteries.<sup>9</sup> The batteries that were manufactured before Congress enacted this statute are not expected to still be in use. In addition, the amount of mercury emissions from batteries prior to disposal is also minimal. Therefore no mercury emissions are expected to be emitted to the air from batteries in 2017.

For this source category, the following SCCs are assigned:

Category	SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
Switches and Relays	2650000002	Waste Disposal, Treatment, and Recovery	Scrap and Waste Materials	Scrap and Waste Materials	Shredding
Fluorescent Lamp Breakage	2861000000	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Non-recycling Related Emissions	Total
Fluorescent Lamp Recycling	2861000010	Miscellaneous Area Sources	Fluorescent Lamp Breakage	Recycling Related Emissions	Total
Dental Amalgam	2850001000	Miscellaneous Area Sources	Health Services	Dental Alloy Production	Overall Process
Laboratory Activities	2851001000	Miscellaneous Area Sources	Laboratories	Bench Scale Reagents	Total
Thermostats / Thermometers	2650000000	Waste Disposal, Treatment, and Recovery	Scrap and Waste Materials	Scrap and Waste Materials	Total: All Processes

## B. Overview of Calculations

This section provides an overview of the calculations used to estimate mercury emissions from each source category. Data sources and calculations are discussed in section C. The process of allocating activity data to the

county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from these mercury categories is discussed in section G.

### **Switches and Relays**

The calculations for estimating mercury emissions from switches and relays involve first estimating the number of switches unrecovered by the state by taking the difference between the total estimated number of switches available and the total switches recovered in each state. The number of unrecovered switches is then apportioned to each county based on the number of car recycling facilities from the US Census County Business Patterns data for NAICS 423930. The total amount of switches unrecovered by county is multiplied by the emissions factor for mercury to estimate mercury emissions from switches and relays.

### **Fluorescent Lamp Breakage/Recycling**

The calculations for estimating the emissions from fluorescent lamp breakage and recycling involve first estimating the average life, in hours, of various fluorescent lamp types. Data from a Freedonia Group Industry Study on the U.S. lamp market is used to estimate the total number of lamps that are discarded or recycled. The number of bulbs recycled is calculated using a recycling rate percentage. This number is then subtracted from all bulbs discarded or recycled to determine the number of bulbs discarded. The activity data are allocated to the county-level based on the share of the population present in each county. An emissions factor is calculated using the amount of mercury available in each fluorescent bulb type. The total amount of fluorescent bulbs recycled or discarded is multiplied by the emissions factor for mercury to estimate mercury emissions from fluorescent lamp breakage and recycling.

### **Dental Amalgam**

The calculations for estimating the emissions from dental amalgam include estimating emissions from both dental fillings and dental office preparation. The number of fillings by age group (for dental fillings) and the total mercury sold in dental amalgam (for dental office preparation) are allocated to the county-level based on the share of the population present in each county. The dental filling data by age group are multiplied by the percent of mercury present in dental fillings to determine the amount of mercury from dental fillings. The total amount of mercury from dental fillings and from dental office preparation are multiplied by emissions factors for mercury and summed together to estimate the total mercury emissions from dental amalgam.

### **Thermostats/Thermometers**

The calculations for estimating the emissions from thermostats and thermometers involve first estimating the total number of thermostats disposed and the amount of mercury in thermometers available for release. The number of thermostats disposed and the amount of mercury in thermometers available for release are allocated to the county-level based on the share of the population present in each county. The total number of thermostats disposed and the amount of mercury in thermometers available for release are multiplied by the emissions factor for mercury and summed together to estimate mercury emissions from thermostats and thermometers.

## **C. Activity Data**

### **Switches and Relays**

The End of Life Vehicle Solutions Corporation (ELVS) provides information on the estimated number of switches available for recovery in each state and the amount of switches actually recovered in 2017.<sup>10,11</sup> There were 1.8 million mercury-containing automobile switches available nationwide in 2017 and 217,634 switches collected for recycling, for a collection rate of 11.7%. Therefore, there were approximately 1.6 million unrecycled automotive switches in 2017 in the United States. The state level number of switches unrecovered is calculated by taking the difference between the total estimated number of switches available and the total switches recovered in each state.

$$UnS_s = TotS_s - RecS_s \quad (SR1)$$

Where:

$UnS_s$  = Total switches unrecovered by state  $s$   
 $TotS_s$  = Total switches available in state  $s$   
 $RecS_s$  = Total switches recovered by state  $s$

### Fluorescent Lamp Breakage/Recycling

Data from a Freedonia Group Industry Study on the U.S. lamp market were used to estimate that approximately 1.485 billion mercury containing lamps, including compact fluorescents (CFLs), linear, and high impact discharge (HID) lamps, were discarded or recycled in 2017.<sup>12</sup> Bulb sales for 2002, 2007, 2012 and projections for 2017 were obtained from Freedonia; sales for all other years were calculated by extrapolating data. Average rated life (hours) of lamp types is used to calculate lifetimes (years), assuming that CFLs are on for 4 hours per day and all other fluorescents and HIDs are on for 8 hours per day.<sup>13,14</sup> Table 1 includes the lifetime data assumed for each bulb type. The lifetime data are used to estimate the year in which bulbs that are discarded or recycled in 2017 would have been purchased.

**Table 1. Lifetime in hours and years for each bulb type<sup>13,14</sup>**

Bulb Type	Life (hrs)	Life (yr)	Purchase Year*	Number of bulbs (million)
CFL	9,000	6	2011	722
Linear	25,000	9	2008	583
HID	17,000	6	2011	180
<i>Total</i>	--	--	--	<i>1,485</i>

\*If bulbs are discarded or recycled in 2017

$$TotB = \sum_b PB_b \quad (FL1)$$

Where:

$TotB$  = Total number of bulbs discarded and recycled, in million units (see Table 1)  
 $PB_b$  = Total number of bulb *type b* purchased

According to a 2010 study by Silveira and Chang, the recycling rate for mercury containing lamps in the U.S. is 23%.<sup>15</sup> Taking into account recycling, this suggests that there were approximately 1,143 million mercury-containing lamps discarded at landfills and approximately 341 million mercury-containing lamps recycled in 2017.

For fluorescent bulbs recycled:

$$RecB = TotB \times RR \quad (FL2)$$

Where:

$RecB$  = Total number of bulbs recycled, in million units  
 $TotB$  = Total number of bulbs discarded and recycled, in million units  
 $RR$  = Recycling rate for mercury containing lamps in the US

For fluorescent bulbs discarded:

$$DiscB = TotB - RecB \quad (FL3)$$

Where:

*DiscB* = Total number of bulbs discarded, in million units  
*TotB* = Total number of bulbs discarded and recycled, in million units  
*RecB* = Total number of bulbs recycled, in million units

### Dental Amalgam

According to a NEWMOA's IMERC factsheet (2015), the amount of mercury in dental amalgam was estimated to be 15.97 tons (31,940 lbs.) in 2013.<sup>16</sup>

The amount of mercury emissions from restored teeth is estimated using data from the National Institutes of Health's National Institute of Dental and Craniofacial Research, which provides estimates of the average number of filled teeth per person, from the CDC National Health and Nutrition Examination Survey (NHANES), in nine different age brackets: 2-5 years, 6-11 years, 12-15 years, 16-19 years, 20-34 years, 35-49 years, 50-64 years, 65-74 years, and 75 and up.<sup>17</sup> The filling data for the age groups 6-11 years, 12-15 years, and 16-19 years are averaged together as are the filling data for the age groups 65-74 years and 75 and up to match the U.S. Census age category, 5-19 and 65 and up. Table 2 lists the average number of filled teeth per person by age group.

**Table 2. Average number of filled teeth per person and percentage of fillings containing mercury by age group.<sup>17</sup>**

Age Group	Average Number of Filled Teeth Per Person	Percentage of Fillings Containing Mercury
0-4	0.47	15.8%
5-19	1.756	31.6%
20-34	4.61	40.8%
35-49	7.78	50%
50-64	9.20	62.5%
65+	8.69	75.0%

According to the American Dental Association (ADA 1998) more than 75% of restorations before the 1970s used amalgam, which declined to 50% by 1991.<sup>18</sup> Using these numbers, it is assumed that 40.8% of the filled teeth for 20-34 age group contain amalgam, 50% of filled teeth in the 35-49 age group, 62.5% of filled teeth in the 50-64 age group, and 75% of filled teeth for people over 65. The BAAQMD memorandum is used to estimate that 31.6% of filled teeth in the 1-19 age group contain amalgam. The Food and Drug Administration has discouraged the use of dental amalgam in children under 6.<sup>19</sup> While EPA does not have data on the percent of fillings containing dental amalgam for the 0-4 age group, it is assumed that the percentage of fillings containing mercury in this age group is approximately half that of the overall under 20 age group.

### Thermostats/Thermometers

A 2002 EPA report estimated that 2-3 million thermostats came out of service in 1994.<sup>8</sup> A 2013 report from a consortium of environmental groups, which assumed that the estimate from the 2002 EPA report remained viable, estimated that the TRC collects at most 8% of the retired thermostats each year.<sup>20</sup> A literature search revealed no new data that could be used to estimate the number of thermostats coming out of service. Therefore, using this estimate, there are approximately 2.3 million thermostats that are not recycled each year.

$$DispTs = RemTs \times (1 - 0.08) \quad (T1)$$

Where:

$DispTs$  = Total thermostats disposed  
 $RemTs$  = Total thermostats removed from service

Data from a NEWMOA's IMERC factsheet suggests that there were 546 lbs. of mercury used in thermometers in 2013.<sup>21</sup> Using past NEWMOA IMERC thermometer data we forecasted the values for mercury in 2014-2017. See Table 3 for the amount of mercury used in thermometers each year from 2013-2017.

**Table 3. Total mercury in thermometers sold and mercury available from thermometers, annually<sup>21</sup>**

Year	Total Mercury in Thermometers Sold (lbs.)	Mercury Available from Thermometers each year (lbs.)
2013	546	519
2014	532	1,024
2015	523	1,496
2016	514	1,936
2017	506	2,345

The US EPA assumes that the average lifespan of a glass thermometer is 5 years, and that 5% of glass thermometers are broken each year.<sup>8</sup> Therefore, using the pounds of mercury available in thermometers each year (shown in Table 3 above) there would be an estimated 2,345 pounds of mercury remaining in thermometers in 2017 (accounting for the breakage rate each year). The following equation calculates the total amount of mercury remaining in thermometers for each year during the lifespan of the thermometer. To calculate the value at the 5 year lifespan mark, the following equation (equation T2) needs to be used to calculate the value for years 2 through 5, with each year building upon the previous year (i.e., the calculation needs to be conducted for all years to find the final year 5 data). See Table 3 for the final values of mercury available from thermometers in 2017, and Table 15 for detailed calculations on how to arrive at the final number.

$$HgTm_n = (HgTm_{n-1} \times 95\%) + HgTmSold_n \quad (T2)$$

Where:

$HgTm_n$  = Amount of mercury remaining in thermometers in year  $n$ , in pounds  
 $HgTm_{n-1}$  = Amount of mercury remaining in thermometers in the year prior to year  $n$ , in pounds  
 $HgTmSold_n$  = Amount of mercury in thermometers in year 1, in pounds  
 $n$  = Year

King et al. (2008) estimate that during the period 2000-2006 there were 350 lbs. of mercury from thermometers collected in recycling programs.<sup>22</sup>

Subtracting the amount of mercury removed due to thermometers being collected in recycling programs from the total amount of mercury remaining in thermometers in 2017 estimates the total amount of mercury in thermometer available for release, in tons. Therefore, there were 1,995 lbs. (0.99 tons) of mercury available for release in 2017.

$$HgTRL = (HgTm_5 - HgTRm) \times \frac{1 \text{ ton}}{2,000 \text{ lbs.}} \quad (T3)$$

Where:

- $HgTRL$  = Amount of mercury in thermometers available for release, in tons
- $HgTm_5$  = Amount of mercury remaining in thermometers in year 5, the lifespan of a thermometer, in pounds
- $HgTRm$  = Amount of mercury removed in thermometer collections, in pounds

## D. Allocation Procedure

### Switches and Relays

The number of unrecovered switches is apportioned to each county based on the number of car recycling facilities. The number of car recycling facilities is estimated using establishment data for recyclable material merchant wholesalers (NAICS 423930) from the U.S. Census Bureau's 2014 County Business Patterns (CBP).<sup>23</sup>

The number of car recycling facilities by county from the US Census County Business Patterns data is first summed to the state level.

$$F_s = \sum_c F_c \quad (SR2)$$

Where:

- $F_s$  = Total car recycling facilities in state  $s$
- $F_c$  = Total car recycling facilities in county  $c$

The share of state car recycling facilities by county is calculated by taking the total number of car recycling facilities in a given county by the total number of car recycling facilities in the state.

$$FracF_c = \frac{F_c}{F_s} \quad (SR3)$$

Where:

- $FracF_c$  = Total fraction of state car recycling facilities in county  $c$
- $F_c$  = Total car recycling facilities in county  $c$
- $F_s$  = Total car recycling facilities in state  $s$

The share of unrecovered switches by county is calculated using the state number of unrecovered switches and the total share of state car recycling facilities by county, calculated above.

$$UnS_c = UnS_s \times FracF_c \quad (SR4)$$

Where:

- $UnS_c$  = Total switches unrecovered in county  $c$
- $UnS_s$  = Total switches unrecovered in state  $s$
- $FracF_c$  = Total share of state car recycling facilities in county  $c$

### Fluorescent Lamp Breakage/Recycling

The national-level mercury emissions from fluorescent lamp breakage are allocated to each county based on population.

$$FracP_c = \frac{P_c}{P_{US}} \quad (FL4)$$

Where:

$FracP_c$  = Fraction of total US population in county  $c$   
 $P_c$  = Population in county  $c$   
 $P_{US}$  = Population in the US

The fraction of total US population in a county is multiplied by the national data for fluorescent bulbs recycled or discarded to calculate the number of fluorescent bulbs recycled or discarded at the county-level.

For fluorescent bulbs discarded:

$$DiscB_c = FracP_c \times DiscB \quad (FL5)$$

Where:

$DiscB_c$  = Total number of bulbs discarded in county  $c$ , in million units  
 $FracP_c$  = Fraction of total US population in county  $c$   
 $DiscB$  = Total number of bulbs discarded in the US, in million units

For fluorescent bulbs recycled:

$$RecB_c = FracP_c \times RecB \quad (FL6)$$

Where:

$RecB_c$  = Total number of bulbs recycled in county  $c$ , in million units  
 $FracP_c$  = Fraction of total US population in county  $c$   
 $RecB$  = Total number of bulbs recycled in the US, in million units

### Dental Amalgam

The amount of mercury from dental office preparations, based on the amount of mercury in dental amalgam from NEWMOA's IMERC factsheet<sup>16</sup>, are allocated to the county level based on population.

$$FracP_c = \frac{P_c}{P_{US}} \quad (DA1)$$

Where:

$FracP_c$  = Fraction of total US population in county  $c$   
 $P_c$  = Total population in county  $c$   
 $P_{US}$  = Total population for the United States

The county-level population fraction is multiplied by the amount of mercury sold for dental amalgam to calculate the total mercury from dental office preparations by county.

$$HgO_c = FracP_c \times HgDA \quad (DA2)$$

Where:

- $HgO_c$  = Total mercury from dental office preparations in county  $c$ , in pounds  
 $FracP_c$  = Fraction of total US population in county  $c$   
 $HgDA$  = Total mercury sold for dental amalgam in the US, in pounds

The emissions from filled teeth are allocated to each county by multiplying the county population by the proportion of the national population in each age group, the average number of filled teeth per person, and the fraction of fillings containing mercury (Table 2; fraction = percentage/100). The age groups listed in Table 2, hereafter referred to as filling groups, are different than official US census bureau age groups; therefore national fractions of each US census bureau age group were calculated, summed, and multiplied by county level population to estimate the county level population for each filling group. Table 6 shows how the US Census age groups correspond to each filling group.

**Table 4. US Census age groups and filling groups**

US Census Age Group	Corresponding Filling Age Group
Under 5	0–4
5–9	5–19
10–14	
15–19	
20–24	20–34
25–29	
30–34	
35–39	35–49
40–44	
45–49	
50–54	50–64
55–59	
60–64	
65–69	65+
70–74	
75–79	
80–84	
85 and up	

First, the share of total population each US Census age group represents to the entire US population is calculated.

$$FracP_a = \frac{P_a}{P_{US}} \quad (DA3)$$

Where:

- $FracP_a$  = Fraction of the total US population in Census Bureau age group  $a$   
 $P_a$  = Total population in Census Bureau age group  $a$   
 $P_{US}$  = Total population for the United States

The fraction of the population for each US Census age group is then summed to match the filling groups.

$$FracP_{fg} = \sum_a FracP_a \quad (DA4)$$

Where:

$FracP_{fg}$  = Fraction of the total US population in filling group  $fg$   
 $FracP_a$  = Fraction of the total US population in census bureau age group  $a$ , where age group  $a$  falls within filling group  $fg$

The fraction of population for each filling group is multiplied by the county-level population data to get the total population for each filling group.

$$P_{fg,c} = FracP_{fg} \times P_c \quad (DA5)$$

Where:

$P_{fg,c}$  = Total population in filling group  $fg$  in county  $c$   
 $FracP_{fg}$  = Fraction of the total US population in filling group  $fg$   
 $P_c$  = Total population in county  $c$

The filling group county-level population is multiplied by the average number of fillings per person in each filling group to determine the total number of fillings in each filling group in each county.

$$F_{fg,c} = P_{fg,c} \times F_{fg} \quad (DA6)$$

Where:

$F_{fg,c}$  = Total fillings in filling group  $fg$  in county  $c$   
 $P_{fg,c}$  = Total population in filling group  $fg$  in county  $c$   
 $F_{fg}$  = Average number of fillings per person in filling group  $fg$

The total fillings in each filling group is then multiplied by the fraction of fillings that contain mercury in each filling group to determine the total number of fillings by filling group in each county.

$$HgF_{fg,c} = F_{fg,c} \times FracHgF_{fg} \quad (DA7)$$

Where:

$HgF_{fg,c}$  = Total fillings containing mercury in filling group  $fg$  in county  $c$   
 $F_{fg,c}$  = Total fillings in filling group  $fg$  in county  $c$   
 $FracHgF_{fg}$  = Fraction of fillings containing mercury in filling group  $fg$

### Thermostats/Thermometers

The national-level mercury emissions from thermostats and thermometers are allocated to the county level based on population.

$$FracP_c = \frac{P_c}{P_{US}} \quad (T4)$$

Where:

$FracP_c$  = Fraction of total US population in county  $c$   
 $P_c$  = Total population in county  $c$   
 $P_{US}$  = Total population for the United States

The fraction of the US population in the county is multiplied by the national data for thermostats and thermometers to calculate the number of thermostats disposed and the amount of mercury in thermometers available for release at the county-level.

For thermostats:

$$DispTs_c = FracP_c \times DispTs \quad (T5)$$

Where:

$DispTs_c$  = Total thermostats disposed of in county  $c$   
 $FracP_c$  = Fraction of total US population in county  $c$   
 $DispTs$  = Total thermostats disposed of in the US

For thermometers:

$$HgTm_c = FracP_c \times HgTmRl \quad (T6)$$

Where:

$HgTm_c$  = Amount of mercury in thermometers available for release in county  $c$ , in pounds  
 $FracP_c$  = Fraction of total US population in county  $c$   
 $HgTmRl$  = Amount of mercury in thermometers available for release in the US, in tons

## E. Emission Factors

### Switches and Relays

The response to comments for the 2007 EPA Significant New Use Rule on Mercury Switches (72 Fed. Reg. 56903), suggests that the weighted average amount of mercury in switches is 1.2 grams (0.0026 lbs.).<sup>24</sup> A report by Griffith et al. (2001) shows that 60% of mercury in switches is released at the shredding operation, while 40% is sent to arc furnaces for smelting.<sup>25</sup> Therefore, the emissions factor for switches is 60% of the emissions factor reported in the 2007 EPA Significant New Use Rule on Mercury Switches response to comment document, 0.00156 lbs. per switch.

### Fluorescent Lamp Breakage/Recycling

The average amount of mercury in a CFL has been studied extensively, with the amount of mercury in each CFL commonly reported as 1.27–4.0 mg (2.63 mg average, Table 7). Linear fluorescent bulbs contain more mercury than CFLs, with a range of 8.3 to 12 mg per bulb (10.15 average, Table 8). Data from the USGS suggests that there is an average of 17 mg of mercury per HID bulb.<sup>26</sup>

**Table 5. Mercury used in CFLs (mg/bulb) as determined by three different studies**

Study	Average Amount of Mercury per CFL (mg)	Source
Li and Jin (2011)	1.27	27
Arendt and Katers (2013)	4.00*	28
Singhvi et al. (2011)	2.63	29
<b>Average</b>	<b>2.63</b>	--

\*Adjusted from 4.5 mg to 4 mg due to increased market penetration of Energy Star CFLs with a lower Hg content.

**Table 6. Mercury used in linear fluorescent bulbs (mg/bulb) as determined by two different studies**

Study	Average Amount of Mercury per Linear Fluorescent Bulb (mg)	Source
Aucott et al. (2004)	12.0	30
NEMA (2005)	8.3	31
<b>Average</b>	<b>10.2</b>	--

Cain et. al (2007) provides the most comprehensive materials flow analysis of mercury intentionally used in products. Their analysis estimates that 10% of all mercury used in fluorescent light bulbs is eventually released to the atmosphere after production and before disposal, with the majority being released during transport to the disposal facility.<sup>32</sup>

The emissions factor for CFL, linear, and HID bulbs are calculated by multiplying the average amount of mercury per bulb discussed above by 10%.

$$EF_{b,p} = Hg_b \times 0.10 \quad (\text{FL7})$$

Where:

$EF_{b,p}$  = Emissions factor by bulb  $b$  for pollutant  $p$ , in mg/bulb  
 $Hg_b$  = Average mercury content per bulb  $b$ , in mg

The emissions factors for all three bulb types can be found in Table 9.

**Table 7. Mercury emissions factors for CFLs, linear fluorescents and HIDs**

Bulb type	Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units
CFL	Mercury	7439976	0.263	mg/bulb
Linear	Mercury	7439976	1.015	mg/bulb
HID	Mercury	7439976	1.7	mg/bulb

A weighted average of all three emissions factors in Table 9 is calculated to estimate total emissions from all fluorescent lamp breakage. The first step estimates the fraction each bulb represents of the total amount of bulbs discarded and recycled.

$$FracTotB_b = \frac{PB_b}{TotB} \quad (\text{FL8})$$

Where:

$FracTotB_b$  = Fraction of bulb type  $b$  discarded and recycled  
 $PB_b$  = Total number of bulb type  $b$  discarded and recycled, in million bulbs  
 $TotB$  = Total number of bulbs discarded and recycled in the US, in million bulbs

A weighted emissions factor for fluorescent lamp breakage is then calculated by multiplying the fraction the bulb type represents of the total number of bulbs by the bulb type-specific emissions factor.

$$EF_{br,p} = \left( \sum_b EF_{b,p} \times \text{FracTot}B_b \right) \times \left( 2.2 \times 10^{-6} \frac{\text{lbs.}}{\text{mg}} \right) \quad (\text{FL9})$$

Where:

$EF_{br,p}$  = Weighted emissions factor for pollutant  $p$  for fluorescent bulb breakage,  $br$ , in lbs./bulb  
 $EF_{b,p}$  = Emissions factor for bulb type  $b$  and pollutant  $p$ , in mg/bulb (see Table 9)  
 $\text{FracTot}B_b$  = Fraction of the number of bulb type  $b$  discarded and recycled

For mercury-containing bulb recycling, the US EPA has estimated an emissions factor of 0.00088 mg/bulb ( $1.9 \times 10^{-9}$  lbs./bulb).<sup>33</sup>

### Dental Amalgam

US EPA (1997) estimates that 2% of mercury used in dental offices is emitted to the air.<sup>33</sup>

Richardson et al. (2011) estimate emissions from filled teeth of approximately 0.3 µg/day of mercury per filled tooth, or  $2.4 \times 10^{-7}$  lbs. per year per filled tooth.<sup>34</sup> The emissions factors used for estimating mercury emissions from dental amalgam are shown in Table 10.

**Table 8. Mercury emissions factors for dental amalgam**

Activity	Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units	Source
Released from dental offices	Mercury	7439976	0.02	Lbs./Lb.	33
Filled teeth	Mercury	7439976	$2.4 \times 10^{-7}$	Lbs./tooth filled	34

### Thermostats/Thermometers

The 2002 EPA report estimates that there are 3 grams of mercury per thermostat.<sup>8</sup> Cain et al. (2007) estimate that 1.5% of mercury in “control devices,” including thermostats, is emitted to the air before it is disposed of at a landfill or incinerator. Therefore the amount of mercury emitted is 0.045 grams per thermostat, or  $9.92 \times 10^{-5}$  lbs. per thermostat.<sup>8,32</sup>

, Leopold (2002) estimates that 5% of thermometers are broken each year. EPA assumes that the remaining 95% of thermometers that are not broken are still in use and therefore do not contribute to emissions. Cain et al. (2007) estimate that 10% of mercury from thermometers is emitted to the air before disposal in a landfill Therefore the emissions factor is estimated to be 10 lbs. of mercury emissions per ton of mercury in thermometers.<sup>8,32</sup>

The emissions factors used for estimating mercury emissions from thermostats and thermometers are shown in Table 11.

**Table 9. Mercury emissions factors for thermostats and thermometers**

Type	Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units	Source
Thermostats	Mercury	7439976	$9.92 \times 10^{-5}$	Lbs./Thermostat	8,32

Type	Pollutant	Pollutant Code	Emissions Factor	Emissions Factor Units	Source
Thermometers	Mercury	7439976	10	Lbs./Ton	8,32

## F. Controls

There are no controls assumed for this category.

## G. Emissions

### Switches and Relays

The total county-level mercury emissions from switches and relays, in pounds, is estimated by multiplying the total switches unrecovered for each county by the emissions factor.

$$E_{s,p,c} = UnS_c \times EF_{s,p} \quad (SR5)$$

Where:

- $E_{s,p,c}$  = Annual emissions of pollutant  $p$  in county  $c$  from switches and relays,  $s$ , in lbs.
- $UnS_c$  = Total switches unrecovered by county  $c$
- $EF_{s,p}$  = Emissions factor for pollutant  $p$  for switches and relays,  $s$ , in lbs./switch

### Fluorescent Lamp Breakage/Recycling

The total county-level mercury emissions for fluorescent lamp breakage and recycling, in pounds, is estimated by multiplying the total fluorescent lamps broken or recycled for each county by the emissions factor.

For fluorescent lamp breakage:

$$E_{br,p,c} = (DiscB_c \times 1,000 \text{ units}) \times EF_{br,p} \quad (FL10)$$

Where:

- $E_{br,p,c}$  = Annual emissions of pollutant  $p$  from fluorescent bulb breakage,  $br$ , by county  $c$ , in lbs.
- $DiscB_c$  = Total number of bulbs discarded for county  $c$ , in million units
- $EF_{br,p}$  = Weighted emissions factor for pollutant  $p$  for fluorescent bulb breakage,  $br$ , in lbs./bulb

For fluorescent lamp recycling:

$$E_{r,p,c} = (RecB_c \times 1,000 \text{ units}) \times EF_{r,p} \quad (FL11)$$

Where:

- $E_{r,p,c}$  = Annual emissions of pollutant  $p$  from fluorescent lamp recycling,  $r$ , by county  $c$ , in lbs.
- $RecB_c$  = Total number of bulbs recycled for county  $c$ , in million bulbs
- $EF_{r,p}$  = Weighted emissions factor for pollutant  $p$  for fluorescent bulb recycling,  $r$ , in lbs./bulb

### Dental Amalgam

The total county-level mercury emissions for dental amalgam from fillings, in pounds, is estimated by multiplying the total number of fillings containing mercury for each county by the emissions factor.

$$E_{f,p,c} = \sum_{fg} HgF_{fg,c} \times EF_{f,p} \quad (DA7)$$

Where:

- $E_{f,p,c}$  = Annual emissions of pollutant  $p$  from dental fillings,  $f$ , by county  $c$ , in lbs.
- $HgF_{fg,c}$  = Total fillings containing mercury in filling group  $fg$  in county  $c$
- $EF_{f,p}$  = Emissions factor for pollutant  $p$  from dental fillings,  $f$ , in lbs./tooth filled

The total county-level mercury emissions for dental office preparation, in pounds, is estimated by multiplying the total pounds mercury from dental office preparations for each county by the emissions factor.

$$E_{o,p,c} = HgO_c \times EF_{o,p} \quad (DA8)$$

Where:

- $E_{o,p,c}$  = Annual emissions of pollutant  $p$  from dental office preparations,  $o$ , by county  $c$ , in lbs.
- $HgO_c$  = Total mercury from dental office preparations by county  $c$ , by pounds
- $EF_{o,p}$  = Emissions factor for pollutant  $p$  for dental office preparations,  $o$ , by lbs./lb.

The emissions from dental fillings and dental office preparations are summed to get the total mercury emissions from dental amalgam.

$$E_{da,p,c} = E_{f,p,c} + E_{o,p,c} \quad (DA9)$$

Where:

- $E_{da,p,c}$  = Annual emissions of pollutant  $p$  from total dental amalgam,  $da$ , by county  $c$ , in lbs.
- $E_{f,p,c}$  = Annual emissions of pollutant  $p$  from dental fillings,  $f$ , by county  $c$ , in lbs.
- $E_{OP,p,c}$  = Annual emissions of pollutant  $p$  from dental office preparations,  $o$ , by county  $c$ , in lbs.

### Thermostats/Thermometers

The total county-level mercury emissions for thermostats, in pounds, is estimated by multiplying the total number of thermostats disposed in each county by the emissions factor.

$$E_{ts,p,c} = DispTs_c \times EF_{ts,p} \quad (T7)$$

Where:

- $E_{ts,p,c}$  = Annual emissions of pollutant  $p$  for thermostats in county  $c$ , in lbs.
- $DispTs_c$  = Total thermostats disposed in county  $c$
- $EF_{ts,p}$  = Emissions factor for pollutant  $p$  for thermostats,  $ts$ , in lbs./thermostat

The total county-level mercury emissions for thermometers, in pounds, is estimated by multiplying the total amount of mercury remaining in thermometers over their lifespan for each county by the emissions factor.

$$E_{t,p,c} = HgTm_c \times EF_{t,p} \quad (T8)$$

Where:

- $E_{t,p,c}$  = Annual emissions of pollutant  $p$  for thermometers in county  $c$ , in lbs.
- $HgTm_c$  = Amount of mercury remaining in thermometers over their lifespan in county  $c$ , in pounds
- $EF_{t,p}$  = Emissions factor for pollutant  $p$  for thermometers, in lbs./ton

The emissions from thermostats and thermometers are summed to get the total mercury emissions.

$$E_{tt,p,c} = E_{ts,p,c} + E_{tm,p,c} \quad (T9)$$

Where:

- $E_{tt,p,c}$  = Annual emissions of pollutant  $p$  for thermostats and thermometers in county  $c$ , in lbs.
- $E_{ts,p,c}$  = Annual emissions of pollutant  $p$  for thermostats in county  $c$ , in lbs.
- $E_{tm,p,c}$  = Annual emissions of pollutant  $p$  for thermometers in county  $c$ , in lbs.

## H. Point Source Subtraction

There are no point source-specific SCCs for the other mercury categories; therefore, point source subtraction is not performed for this category.

## I. Sample Calculations

### Switches and Relays

Table 12 lists sample calculations to estimate the mercury emissions from switches and relays in Hartford County, Connecticut.

**Table 10. Sample calculations for mercury emissions from switches and relays for Hartford County, CT**

Eq. #	Equation	Values for Hartford County, Connecticut	Result
1	$UnS_s = TotS_s - RecS_s$	22,000 switches available – 618 switches recovered	21,382 unrecovered switches in Connecticut
2	$F_s = \sum_{cs} F_c$	$\sum$ All facilities in Connecticut	85 car recycling facilities in Connecticut
3	$FracF_c = \frac{F_c}{F_s}$	$\frac{18 \text{ facilities in Hartford County, CT}}{85 \text{ facilities in CT}}$	0.2118 share of state car recycling facilities in Hartford County, CT
4	$UnS_c = UnS_s \times FracF_c$	21,382 unrecovered switches $\times$ 0.2118 share of state facilities	4,528 unrecovered switches in Hartford County, CT
5	$E_{s,p,c} = UnS_c \times EF_{s,p}$	4,528 switches $\times$ 0.00156 $\frac{\text{lbs.}}{\text{switch}}$	7.06 pounds of mercury from switches and relays in Hartford County, CT

### Fluorescent Lamp Breakage/Recycling

Table 13 lists sample calculations to estimate the mercury emissions from fluorescent lamp breakage in Hartford County, Connecticut.

**Table 11. Sample calculations for mercury emissions from fluorescent lamp breakage for Hartford County, Connecticut**

Eq. #	Equation	Values for Hartford County, Connecticut	Result
1	$TotB = \sum_b PB_b$	$\sum$ all bulbs recycled or discarded	1,485 million bulbs discarded and recycled in the US in 2014
2	$RecB = TotB \times RR$	1,485 million recycled and discarded bulbs $\times$ 23% recycling rate	341 million bulbs recycled in the US in 2014
3	$DiscB = TotB - RecB$	1,485 million recycled and discarded bulbs – 341 million recycled bulbs	1,143 million bulbs discarded in the US in 2014
4	$FracP_c = \frac{P_c}{P_{US}}$	$\frac{895,388 \text{ people in Hartford County, CT}}{318,857,056 \text{ people in the US}}$	0.272% of total US population is in Hartford County, CT
5	$DiscB_c = FracP_c \times DiscB$	$0.00272 \times 1,143 \text{ million bulbs}$	3.109 million fluorescent bulbs discarded in Hartford County, CT
6	$RecB_c = FracP_c \times RecB$	$0.00272 \times 341 \text{ million bulbs}$	0.928 million fluorescent bulbs recycled in Hartford County, CT
7	$EF_{b,p} = Hg_b \times 0.10$	CFL: $2.63 \text{ mg Hg} \times 10\%$ Linear: $10.2 \text{ mg Hg} \times 10\%$ HID: $17 \text{ mg Hg} \times 10\%$	0.263 mg Hg/CFL bulb 1.02 mg Hg/linear bulb 1.7 mg Hg/HID bulb
8	$FracTotB_b = \frac{PB_b}{TotB}$	CFL: $\frac{722 \text{ million CFL bulbs}}{1,485 \text{ million bulbs total}}$ Linear: $\frac{583 \text{ million Linear bulbs}}{1,485 \text{ million bulbs total}}$ HID: $\frac{180 \text{ million HID bulbs}}{1,485 \text{ million bulbs total}}$	48.6% of total for CFL 39.2% of total for Linear 12.1% of total for HID
9	$EF_{br,p} = (\sum_b EF_{b,p} \times FracTotB_b) \times (2.2 \times 10^{-6} \frac{lbs.}{mg})$	$\left( \left( 0.263 \frac{mg}{bulb} \times 48.6\% \right) + \left( 1.02 \frac{mg}{bulb} \times 39.2\% \right) + \left( 1.7 \frac{mg}{bulb} \times 12.1\% \right) \right) \times \left( 2.2 \times 10^{-6} \frac{lbs.}{mg} \right)$	$1.61 \times 10^{-6}$ lbs. Hg/bulb weighted emissions factor for mercury for fluorescent lamp breakage
10	$E_{br,p,c} = (DiscB_c) \times EF_{br,p}$	$3,109,617 \text{ bulbs} \times \left( 1.61 \times 10^{-6} \frac{lbs. Hg}{bulb} \right)$	5.0 lbs. of mercury from fluorescent lamp breakage in Hartford County, CT

Eq. #	Equation	Values for Hartford County, Connecticut	Result
11	$E_{r,p,c} = (RecB_c) \times EF_{r,p}$	$928,846 \text{ bulbs} \times \left(1.94 \times 10^{-9} \frac{\text{lbs. Hg}}{\text{bulb}}\right)$	$1.8 \times 10^{-4}$ lbs. of mercury from fluorescent lamp recycling in Hartford County, CT

### Dental Amalgam

Table 14 lists sample calculations to determine the mercury emissions from dental amalgam in Hartford County, Connecticut. The example will show the process for the 5-19 age group, with the total sum of emissions in the final step.

**Table 12. Sample calculations for mercury emissions from dental amalgam for Hartford County, Connecticut**

Eq. #	Equation	Values for Hartford County, Connecticut	Result
1	$FracP_c = \frac{P_c}{P_{US}}$	$\frac{895,338 \text{ people in Hartford County, CT}}{329,164,967 \text{ people in the US}}$	0.272% of total US population is in Hartford County, CT
2	$HgO_c = FracP_c \times HgDA$	$0.272\% \times 31,940 \text{ lbs.}$	86.88 lbs. total mercury from dental office preparations in Hartford County, CT
3	$FracP_a = \frac{P_a}{P_{US}}$	5 to 9: $\frac{20,304,238 \text{ people, 5 to 9 age group}}{325,719,178 \text{ people in the US}}$ 10 to 14: $\frac{20,778,454 \text{ people, 10 to 14 age group}}{325,719,178 \text{ people in the US}}$ 15 to 19: $\frac{21,131,660 \text{ people, 14 to 19 age group}}{325,719,178 \text{ people in the US}}$	6.23% of total US population for 5-9 age group 6.38% of total US population for 10-14 age group 6.49% of total US population for 14-19 age group
4	$FracP_{fg} = \sum_a FracP_a$	$\sum 6.23\% + 6.38\% + 6.49\%$	19.1006% of total US population for 5-19 age group
5	$P_{fg,c} = FracP_{fg} \times P_c$	$19.1006\% \times 895,338 \text{ people in Hartford County, CT}$	171,025 people in the 5-19 age group in Hartford County, CT
6	$F_{fg,c} = P_{fg,c} \times F_{fg}$	$171,025 \text{ people 5 – 19 in Hartford County, CT} \times 1.756 \text{ fillings, 5 – 19 age group}$	300,433 fillings in the 5-19 age group in Hartford County, CT
7	$HgF_{fg,c} = F_{fg,c} \times FracHgF_{fg}$	$300,433 \text{ fillings, 5 – 19 age group} \times 31.6\%$	94,936 total fillings containing mercury in the 5-19 age group in Hartford County, CT

Eq. #	Equation	Values for Hartford County, Connecticut	Result
8	$E_{f,p,c} = \sum_{fg} HgF_{fg,c} \times EF_{f,p}$	$94,936 \text{ fillings with mercury, 5-19 age group} \times \left( 2.4 \times 10^{-7} \frac{\text{lbs.}}{\text{tooth filled}} \right)$	0.023 pounds of mercury emissions from fillings in the 5-19 age group (0.722 pounds of mercury in all age groups) in Hartford County, CT
9	$E_{o,p,c} = HgO_c \times EF_{o,p}$	$86.88 \text{ lbs.} \times 0.02 \frac{\text{lbs.}}{\text{lb.}}$	1.74 pounds of mercury emissions from dental office preparations in Hartford County, CT
10	$E_{da,p,c} = E_{f,p,c} + E_{o,p,c}$	$0.722 \text{ pounds} + 1.74 \text{ pounds}$	2.46 pounds of mercury from dental amalgam in Hartford County, CT

### Thermostats/Thermometers

Table 15 lists sample calculations to determine the mercury emissions from thermostats and thermometers in Hartford County, Connecticut.

**Table 13. Sample calculations for mercury emissions from thermostats and thermometers for Hartford County, Connecticut**

Eq. #	Equation	Values for Hartford County, Connecticut	Result
1	$DispTs = RemTs \times (1 - 8\%)$	$2,500,000 \text{ thermostats removed from service} \times 92\%$	2,300,000 thermostats disposed of in the United States in 2017
2	$HgTm_n = (HgTm_{n-1} \times 95\%) + HgTm_1$	$y = 1: 546 \text{ lbs.} \times 95\%$ $y = 2: (518.7 \text{ lbs.} \times 95\%) + 532 \text{ lbs.}$ $y = 3: (1,024 \text{ lbs.} \times 95\%) + 523 \text{ lbs.}$ $y = 4: (1,496 \text{ lbs.} \times 95\%) + 514 \text{ lbs.}$ $y = 5: (1,935 \text{ lbs.} \times 95\%) + 506 \text{ lbs.}$	2,345 pounds of mercury available for release in thermometers in year 2017
3	$\frac{HgTRl}{\frac{1 \text{ ton}}{2,000 \text{ lbs.}}} = (HgTm_5 - HgTRm) \times$	$2,345 \text{ lbs.} - 350 \text{ lbs.} \times \frac{1 \text{ ton}}{2,000 \text{ lbs.}}$	0.99 tons of total mercury in thermometers available for release
4	$FracP_c = \frac{P_c}{P_{US}}$	$\frac{895,388 \text{ people in Hartford County, CT}}{329,164,967 \text{ people in the US}}$	0.272% of total US population is in Hartford County, CT
5	$DispTs_c = FracP_c \times DispTs$	$0.272\% \times 2,300,000 \text{ thermostats}$	6,256 thermostats disposed in Hartford County, CT

Eq. #	Equation	Values for Hartford County, Connecticut	Result
6	$HgTm_c = FracP_c \times HgTmRl$	$0.272\% \times 0.99 \text{ tons}$	0.0027 tons of mercury from thermometers available for release in Hartford County, CT
7	$E_{ts,p,c} = DispTs_c \times EF_{ts,p}$	$6,256 \text{ thermostats} \times \left(9.92 \times 10^{-5} \frac{\text{lbs.}}{\text{thermostat}}\right)$	0.62 pounds of mercury emissions from thermostats in Hartford County, CT
8	$E_{t,p,c} = HgTm_c \times EF_{t,p}$	$0.0027 \text{ tons} \times 10 \frac{\text{lbs.}}{\text{ton}}$	0.027 pounds of mercury emissions from thermometers in Hartford County, CT
9	$E_{tt,p,c} = E_{ts,p,c} + E_{t,p,c}$	$0.62 \text{ lbs.} + 0.027 \text{ lbs.}$	0.647 pounds of mercury emissions from thermostats and thermometers in Hartford County, CT

## J. Changes from 2014 Methodology

There are no significant changes from the 2014 NEI emissions estimation methodology for these mercury sources.

## K. Puerto Rico and US Virgin Islands Emissions Calculations

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in pounds for these two Florida counties are divided by their respective populations creating a pound per capita emission factor. For each Puerto Rico and US Virgin Island county, the pound per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which serves as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

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## PUBLICLY OWNED TREATMENT WORKS

### A. Source Category Description

Publicly Owned Treatment Works (POTWs) include treatment works that are owned by a state, municipality, city, town, special sewer district, or other publicly owned and financed entity as opposed to a privately (industrial) owned treatment facility. The definition includes intercepting sewers, outfall sewers, sewage collection systems, pumping, power, and other equipment. The wastewater treated by these POTWs is generated by industrial, commercial, and domestic sources.<sup>1</sup> In 2017, POTWs in the US, Puerto Rico, and US Virgin Islands resulted in more than 4,300 tons of VOC emissions and 860 tons of NH<sub>3</sub> emissions.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2630020000	Waste Disposal, Treatment, and Recovery	Wastewater Treatment	Public Owned	Total Processed

### B. Overview of Calculations

The calculations for estimating the emissions from POTWs involve multiplying the wastewater flow rate by emissions factors for VOCs, NH<sub>3</sub>, and 53 HAPs. Sources of data and calculations for the wastewater flow rate are discussed in section C. The process of allocating activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from POTWs is discussed in section G. Correcting for point sources is discussed in section H.

### C. Activity Data

The activity data for this source category is the wastewater flow rate. The EPA Clean Watersheds Needs Survey provides flow rate by facility and estimates the national POTW flow rate in 2012 for all facilities as 32,822 million gallons per day (MMGD).<sup>2</sup> The nationwide flow rate includes Puerto Rico and the US Virgin Islands. To estimate flow rates in 2017, facility-level daily flow rates in 2012 are multiplied by the ratio of 2017 to 2012 population in the county where the facility resides.<sup>3</sup> County-level annual 2017 wastewater flow rates are calculated by summing the daily flow rates for all POTWs within the county and multiplying by 365 days in a year.

$$FR_{c,2017} = \sum_{f=1}^n FR_{f,2012} \times 365 \times \frac{P_{c,2017}}{P_{c,2012}} \quad (1)$$

Where:

$FR_{c,2017}$  = The annual wastewater flow rate of county  $c$  in 2017  
 $FR_{f,2012}$  = The daily wastewater flow rate at facility  $f$  in 2012  
 $P_{c,2017}$  = Total population of county  $c$  in 2017  
 $P_{c,2012}$  = Total population of county  $c$  in 2012

### D. Allocation Procedure

For a given county, county-level wastewater flow rates are calculated by summing the flow rates for all POTWs within the county.

## E. Emissions Factors

Emissions factors for POTWs are reported in Table 1. The ammonia emissions factor was obtained from an EPA report<sup>5</sup> and the VOC emissions factor was based on a TriTAC study.<sup>6</sup> Emissions factors for HAPs were derived using 1996 area source emissions estimates that were provided by Bob Lucas<sup>7</sup> and the 1996 nationwide flow rate.<sup>8</sup> These HAP emissions factors were then multiplied by the 2008 to 2002 VOC emissions factor ratio (0.85/9.9) to obtain the final HAP emissions factors applied in the 2017 inventory.

**Table 1. Emissions Factors for Publicly Owned Treatment Works (SCC 2630020000)**

<b>Pollutant</b>	<b>Pollutant Codes</b>	<b>Emissions Factor (lbs./MMGAL)</b>	<b>Emissions Factor Reference(s)</b>
1,1,2,2-Tetrachloroethane	79345	1.75E-06	7, 8
1,1,2-Trichloroethane	79005	1.17E-06	7, 8
1,2,4-Trichlorobenzene	120821	8.67E-05	7, 8
1,3-Butadiene	106990	2.51E-05	7, 8
1,4-Dichlorobenzene	106467	2.16E-04	7, 8
1-Chloro-2,3-Epoxypropane	106898	4.52E-06	7, 8
2,4-Dinitrotoluene	121142	4.81E-05	7, 8
2-Nitropropane	79469	2.92E-07	7, 8
Acetaldehyde	75070	3.10E-04	7, 8
Acetonitrile	75058	3.45E-04	7, 8
Acrolein	107028	3.84E-04	7, 8
Acrylonitrile	107131	3.86E-04	7, 8
Allyl Chloride	107051	1.94E-05	7, 8
Ammonia	NH3	1.69E-01	5
Benzene	71432	6.73E-03	7, 8
Benzyl Chloride	100447	8.17E-06	7, 8
Biphenyl	92524	7.52E-05	7, 8
Carbon Disulfide	75150	4.32E-03	7, 8
Carbon Tetrachloride	56235	1.12E-03	7, 8
Chlorobenzene	108907	4.83E-04	7, 8
Chloroform	67663	6.44E-03	7, 8
Chloroprene	126998	2.38E-05	7, 8
Cresols/Cresylic Acid (Isomers and Mixture)	1319773	1.61E-06	7, 8
Dimethyl Sulfate	77781	1.31E-06	7, 8
Ethyl Acrylate	140885	1.75E-06	7, 8
Ethyl Benzene	100414	7.66E-03	7, 8
Ethylene Oxide	75218	2.22E-04	7, 8
Formaldehyde	50000	1.97E-05	7, 8
Glycol Ethers	171	1.15E-02	7, 8
Hexachlorobutadiene	87683	7.29E-07	7, 8
Hexachlorocyclopentadiene	77474	5.83E-07	7, 8
Methanol	67561	1.14E-02	7, 8
Methyl Chloroform	71556	5.63E-04	7, 8
Methyl Isobutyl Ketone	108101	2.69E-03	7, 8
Methyl Methacrylate	80626	3.11E-04	7, 8
Methyl Tert-Butyl Ether	1634044	6.37E-05	7, 8

Pollutant	Pollutant Codes	Emissions Factor (lbs./MMGAL)	Emissions Factor Reference(s)
Methylene Chloride	75092	9.10E-03	7, 8
N,N-Dimethylaniline	121697	3.22E-04	7, 8
Naphthalene	91203	1.31E-03	7, 8
Nitrobenzene	98953	6.56E-06	7, 8
O-Toluidine	95534	1.75E-06	7, 8
P-Dioxane	123911	1.79E-05	7, 8
Propionaldehyde	123386	3.50E-06	7, 8
Propylene Dichloride	78875	1.15E-05	7, 8
Propylene Oxide	75569	7.32E-04	7, 8
Styrene	100425	2.73E-03	7, 8
Tetrachloroethylene	127184	4.27E-03	7, 8
Toluene	108883	1.23E-02	7, 8
Trichloroethylene	79016	3.06E-04	7, 8
Vinyl Acetate	108054	7.66E-05	7, 8
Vinyl Chloride	75014	6.71E-06	7, 8
Vinylidene Chloride	75354	4.23E-04	7, 8
Volatile Organic Compounds	VOC	8.50E-01	6
Xylenes (Mixture of O, M, And P Isomers)	1330207	5.98E-02	7, 8

## F. Controls

There are no controls assumed for this category.

## G. Emissions

Emissions are estimated by multiplying an emissions factor by the county flow rate. A conversion factor was used to convert pounds to tons.

$$E_{p,c,2017} = FR_{c,2017} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lbs.}} \quad (2)$$

Where:

$E_{p,c,2017}$  = Nonpoint emissions in 2017 of pollutant  $p$  in county  $c$ , in tons  
 $FR_{c,2017}$  = Flow rate in 2017 in county  $c$ , in MMGY  
 $EF_p$  = Emissions factor for pollutant  $p$ , in lbs. per MMGAL

## H. Point Source Subtraction

The county-level flow rates include all facilities reported as POTWs in the EPA Clean Watersheds Needs Survey. In some cases, SLT agencies might include facilities under their point source inventory reporting. In these cases, SLT agencies have two options for submitting state-level point source data to EPA for point source subtraction:

- **Option A:** County-level flow rates associated with POTWs reported as point sources; or
- **Option B:** County-level emissions of VOC and NH<sub>3</sub> for POTWs reported as point sources.

## I. Sample Calculations

Table 2 lists sample calculations to determine the benzene emissions for nonpoint source POTWs for Autauga County, Alabama.

**Table 2. Sample calculations for benzene emissions for nonpoint source POTWs for Autauga County, AL.**

Eq. #	Equation	Values for Autauga County, AL	Result
1	$FR_{c,2017} = \sum_{f=1}^n FR_{f,2012} \times 365 \times \frac{P_{c,2017}}{P_{c,2012}}$	$2.866 \text{ MMGD} \times 365 \text{ days} \times \frac{55,504 \text{ people}}{54,927 \text{ people}}$	1,057.07 MMGY
2	$E_{p,c,2017} = FR_{c,2017} \times EF_p \times \frac{1 \text{ ton}}{2000 \text{ lbs.}}$	$1,057.07 \text{ MMGY} \times 0.00673 \text{ lb/MMG} \times \frac{1 \text{ ton}}{2000 \text{ lbs.}}$	0.003557 tons benzene per year

## J. Changes from 2014 Methodology

County-level flow rates in 2017 were determined by summing facility-level data to the county-level rather than allocating the national flow rate to counties based on the ratio of county to US population.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are not multiplied by the ratio of 2017 to 2012 population since 2017 Census Data does not exist for the U.S. Virgin Islands.

## L. Instructions for Submitting Point Activity or Emissions Data to Input Template

The POTWs Input Template includes a template for submitting point source activity or emissions data. The template includes two options for submitting point source data: either submitting point source activity (flow rates in millions of gallons associated with point-source POTWs) or emissions (VOC and NH3). SLT agencies should submit data only for one option. The point data, whether it is activity or emissions, should be submitted at the county level.

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- <sup>4</sup> U.S. Environmental Protection Agency, “Wastewater Flow Projections for POTWs and Privately and Federally Owned Treatment Works in 2000, 2005, and 2010,” Table A-8 in Biosolids Generation, Use, and Disposal in the United States, EPA530-R-99-009, September 1999. <https://nepis.epa.gov/Exec/QueryNET.exe/10001529.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000014%5C10001529.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL>
- <sup>5</sup> Stephen M. Roe, Melissa D. Spivey, Holly C. Lindquist, Kirstin B. Thesing, and Randy P. Strait, E.H. Pechan &

Associates, Inc., Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources – Draft Final Report, prepared for U.S. Environmental Protection Agency, Emission Inventory Improvement Program, April 2004. [https://www.epa.gov/sites/production/files/2015-08/documents/eiip\\_areasourcesnh3.pdf](https://www.epa.gov/sites/production/files/2015-08/documents/eiip_areasourcesnh3.pdf)

<sup>6</sup> Prakasam Tata, Jay Witherspoon, Cecil Lue-Hing (eds.), VOC Emissions from Wastewater Treatment Plants: Characterization, Control, and Compliance, Lewis Publishers, 2003, p. 261.

<sup>7</sup> Memorandum from Bob Lucas, U.S. Environmental Protection Agency to Greg Nizich, U.S. Environmental Protection Agency, “Review of Baseline Emissions Inventory,” 16 October 1998.

<sup>8</sup> U.S. Environmental Protection Agency, “Facilities Database (Needs Survey) - Frequently Asked Questions,” at <https://permanent.access.gpo.gov/websites/epagov/www.epa.gov/OWM/mtb/cwns/1996rtc/faqwfd.htm>, accessed 30 April 2019.

## RESIDENTIAL BARBECUE GRILLING

### A. Source Category Description

Residential barbecue grilling emissions include emissions from the burning of charcoal (including the use of lighter fluid) and emissions from all types of meat cooked on charcoal, gas, and electric grills. Combustion emissions from gas barbecue grills are not included.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2810025000	Miscellaneous Area Sources	Other Combustion	Charcoal Grilling	Residential

### B. Overview of Calculations

Emissions from this source category include criteria pollutants, (CO, NO<sub>x</sub>, PM<sub>10</sub>-PRI, PM<sub>25</sub>-PRI and VOC) and HAP emissions from residential barbecue grilling. Sources of emissions include burning charcoal and using lighter fluid in charcoal grills, and cooking meat on charcoal, gas, and electric grills. To perform the relevant calculations data are needed on activities and emissions factors for those activities. Activity data includes information about total charcoal sold, total meat cooked, and total amount of lighter fluid used.

The sources of activity data and relevant calculations are discussed further in section C. The process of allocating the charcoal to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from residential barbecue grilling is discussed in section G.

### C. Activity Data

There are three types of activity data for this source category: (1) amount of meat cooked on charcoal grills; (2) amount of meat cooked on gas and electric grills; and (3) number of grilling events using lighter fluid. Each of these types of activity data is discussed in the subsections below.

#### *Meat cooked on charcoal grills*

This source category includes emissions from the amount of charcoal burned and the amount of meat cooked.

The total amount of charcoal sold in the United States is based on data from the Heath, Patio, and Barbecue Association (HPBA),<sup>1</sup> which is distributed to each county based on the proportion of 1-4 unit homes in each county, from the U.S. Census Bureau.<sup>2</sup> This distribution procedure is discussed in more detail in Section D. We assume that all charcoal sold is burned.

The amount of meat cooked is determined based on assumptions about the amount of meat cooked per pound of charcoal sold. This calculation assumes 17.64 charcoal briquettes per pound of charcoal sold<sup>3</sup> and 0.033 pounds of meat cooked per briquette.<sup>4,5</sup> These numbers are multiplied together to calculate a value of 0.588 pounds of meat cooked per pound of charcoal sold.

$$\begin{aligned} 0.588 \text{ lb. meat cooked per lb. charcoal sold} \\ = 17.64 \text{ briquettes per lb. charcoal} \times 0.033 \text{ lb. meat cooked per briquette} \end{aligned} \quad (1)$$

#### *Meat cooked on gas and electric grills*

The amount of meat cooked on gas grills is calculated based on assumptions about the ratio of gas grilling to charcoal grilling, including that charcoal grills represent 41% of grills and gas/electric grills represent 59%,<sup>6</sup> and that charcoal grills are used 27 times per year and gas/electric grills are used 45 times per year.<sup>7</sup> This calculation

results in an estimated ratio of 2.398, meaning that for every pound of meat cooked on a charcoal grill an additional 2.398 pounds of meat are cooked on a gas or electric grill.

$$\begin{aligned} & \text{2.398 gas or electric grilling ratio} \\ &= \frac{45 \text{ times per year (gas or electric)} \times 59\% \text{ gas or electric grills}}{27 \text{ times per year (charocal)} \times 41\% \text{ charcoal grills}} \end{aligned} \quad (2)$$

The values from equations 1 and 2 are used with national data on the amount of charcoal sold from the HPBA <sup>Error! Bookmark not defined.</sup> to estimate the total amount of meat cooked on charcoal, gas, and electric grills. This national charcoal sales data is distributed to the counties based on the number of homes in each county, as described in the following section.

#### *Grilling events using lighter fluid*

This calculation is based on the percentage of homes that have a grill (80%),<sup>8</sup> the percentage of grills that are charcoal grills (41%),<sup>6</sup> the percentage of charcoal grills that use lighter fluid (37%),<sup>9</sup> and the number of times per year that charcoal grills are used (27).<sup>7</sup> This results in a value of approximately 3.28 grilling events per household per year where lighter fluid is used.

$$\begin{aligned} & \text{3.28 grilling events with lighter fluid} \\ &= 80\% \text{ homes with a grill} \times 41\% \text{ grills that are charcoal} \\ &\times 37\% \text{ charcoal grills that use lighter fluid} \\ &\times 27 \text{ times per year charcoal grills are used} \end{aligned} \quad (3)$$

This number is multiplied by the number of occupied homes in each county to determine the total number of grilling events in each county where lighter fluid is used. Seen Section D on allocation procedure for information on calculating the number of occupied 1-4 unit households.

$$n_{LF,c} = H_{c,o} \times 3.28 \quad (4)$$

Where:

- $n_{LF,c}$  = Number of grilling events in county  $c$  where lighter fluid is used
- $H_{c,o}$  = Total occupied households of 1-4 units in county  $c$
- 3.28 = Number of grilling events with lighter fluid per home, from equation 3

## **D. Allocation Procedure**

National data on the amount of charcoal sold is distributed to the counties based on the proportion of occupied 1-4 unit homes in each county. It is assumed that households in larger apartment buildings would not have the space to have or use an outdoor grill. The data on the number of occupied 1-4 unit homes in each county is from the U.S. Census Bureau American Community Survey. <sup>Error! Bookmark not defined.</sup> Occupied households between 1 and 4 units are estimated using the sum of total 1-4 unit households and the fraction of total occupied households in the US.

$$H_{c,o} = \sum_{units=1}^{units=4} H_{c,t} \times \frac{H_{US,o}}{H_{US,t}} \quad (5)$$

$$HR_c = \frac{H_{c,o}}{\sum_c H_o} \quad (6)$$

Where:

- $H_{c,o}$  = Total occupied households of 1-4 units in county  $c$
- $H_{c,t}$  = Total households in county  $c$

$H_{US,o}$  = Total occupied households in the United States  
 $H_{US,t}$  = Total households in the United States  
 $HR_c$  = Ratio of occupied households of 1-4 units in county  $c$  to total households of 1-4 units in United States

The national-level data on charcoal sales is distributed to the counties using the ratio from equation 6.

$$Charcoal_c = HR_c \times Charcoal_{US} \times 2000 \text{ lbs. per ton} \quad (7)$$

Where:

$Charcoal_c$  = Amount of charcoal sold in county  $c$ , in pounds  
 $HR_c$  = Ratio of households of 1-4 units in county  $c$  to total households of 1-4 units in United States  
 $Charcoal_{US}$  = Amount of charcoal sold in the United States, in tons

The amount of charcoal sold in each county (from equation 7) is multiplied by the amount of meat cooked per pound of charcoal (from equation 1) to estimate the amount of meat cooked on charcoal grills in each county.

$$Meat_{charcoal,c} = Charcoal_c \times 0.588 \quad (8)$$

Where:

$Meat_{charcoal,c}$  = Amount of meat cooked on charcoal grills in county  $c$ , in pounds  
 $Charcoal_c$  = Amount of charcoal sold in county  $c$ , in pounds  
 0.588 = Pounds of meat cooked per pound of charcoal, from equation 1

The amount of meat cooked on charcoal grills is used with the ratio from equation 2 to estimate the amount of meat cooked on gas or electric grills.

$$Meat_{gas/elec,c} = Meat_{charcoal,c} \times 2.398 \quad (9)$$

Where:

$Meat_{gas/elec,c}$  = Amount of meat cooked on gas or electric grills in county  $c$ , in pounds  
 $Meat_{charcoal,c}$  = Amount of meat cooked on charcoal grills in county  $c$ , in pounds  
 2.398 = Ratio of meat cooked on gas or electric grills to charcoal grills, from equation 2

The amount of meat cooked on charcoal and on gas or electric grills is added together to determine the total amount of meat cooked on grills in each county.

$$Meat_{t,c} = Meat_{gas/elec,c} + Meat_{charcoal,c} \quad (10)$$

Where:

$Meat_{t,c}$  = Total amount of meat cooked on grills in county  $c$ , in pounds  
 $Meat_{gas/elec,c}$  = Amount of meat cooked on gas or electric grills in county  $c$ , in pounds  
 $Meat_{charcoal,c}$  = Amount of meat cooked on charcoal grills in county  $c$ , in pounds

## E. Emissions Factors

The emissions factors are shown in Table 1, including the actual emissions factor used in the calculations, and the original emissions factor from the reference, if it is different from the actual factor. The emissions factors for CO, NOX, PM10-PRI, PM25-PRI, and VOC are from EPA's report, *Emissions from Street Vendor Cooking Devices (Charcoal Grilling)*.<sup>10</sup> There is also a separate emissions factor for VOC from lighter fluid, from the South Coast Air Quality Management District, Rule 1174.<sup>11</sup> The HAP emission factors are speciation factors from the EPA SPECIATE database,<sup>12</sup> which are speciation factors for charbroiling meat.

**Table 1. Emissions Factors for Residential Grilling (2810025000)**

Pollutant	Pollutant Code	Emissions Factor (original)	Emissions Factor Units (original)	Emissions Factor (actual)	Emissions Factor Units (actual)	Emissions Factor Reference
CO	CO	162.97a	g/kg meat	325.93	lbs./ton meat	10, Table E-2
NOX	NOX	3.37a		6.74		
PM10-PRI	PM10-PRI	9.10a		18.19		
PM25-PRI	PM25-PRI	na		14.56b		
		0.94a		1.88		
VOC	VOC			0.02	lbs./grilling event	11, section (c)(1)
1,3-Butadiene	106990			1.04E-02	lbs./lb. VOC	12
2,2,4-Trimethylpentane	540841			1.12E-03		
Acetaldehyde	75070			1.09E-01		
Anthracene	120127			1.09E-05		
Benzene	71432			8.26E-03		
Ethyl Benzene	100414			1.09E-03		
Fluoranthene	206440			3.98E-05		
Formaldehyde	50000			1.38E-01		
Hexane	110543			4.38E-03		
m-Xylene	108383			5.97E-04		
Naphthalene	91203			8.94E-04		
o-Xylene	95476			1.09E-03		
Phenanthrene	85018			1.20E-04		
Propionaldehyde	123386			5.01E-02		
p-Xylene	106423			5.97E-04		
Pyrene	129000			5.67E-05		
Toluene	108883			3.98E-03		

- a. Based on average of test numbers MC1, MC2, MC3, MC6, MC7, and MC8 from the table showing emissions factors for emissions per kg meat cooked. See Table E-2 in Reference 10.
- b. PM25-PRI emission factor is based on assumption that PM25-PRI = PM10-PRI × 0.8.

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The emissions of PM10-PRI, PM25-PRI, and VOC for residential barbecue grilling are calculated by multiplying the amount of meat grilled in each county (from equation 10) by the emissions factors from Table 1.

$$E_{p,c} = \frac{Meat_{t,c}}{2000 \text{ lbs. per ton}} \times EF_{p,meat} \quad (11)$$

Where:

- $E_{p,c}$  = Emissions of pollutant  $p$  from grilling meat in county  $c$ , in pounds
- $Meat_{t,c}$  = Total amount of meat cooked on grills in county  $c$ , in pounds
- $EF_{p,meat}$  = Emissions factor for pollutant  $p$  from grilling meat

It is assumed that CO and NOX emissions are from charcoal combustion, and there are no significant emissions of these pollutants from gas or electric grills. Therefore, to estimate CO and NOX emissions, the emissions factors for these pollutants are multiplied by the amount of meat cooked on charcoal (from equation 8), rather than the total

amount of meat cooked.

$$E_{CO/NOX,c} = \frac{Meat_{charcoal,c}}{2000 \text{ lbs. per ton}} \times EF_{CO/NOX} \quad (11a)$$

Where:

- $E_{CO/NOX,c}$  = Emissions of pollutant CO or NOX from grilling meat in county  $c$ , in pounds
- $Meat_{charcoal,c}$  = Total amount of meat cooked on charcoal grills in county  $c$ , in pounds
- $EF_{CO/NOX}$  = Emissions factor for CO or NOX from grilling meat

For VOC, there is a separate calculation to account for emissions from lighter fluid use, in which the number of grilling events per year where lighter fluid is used (from equation 4) is multiplied by an emissions factor of 0.02 lbs. VOC/grilling event (Table 1).

$$E_{VOC,LF,c} = n_{LF,c} \times EF_{VOC,LF} \quad (12)$$

Where:

- $E_{VOC,LF,c}$  = Emissions of VOC from lighter fluid use in county  $c$ , in pounds
- $n_{LF,c}$  = Number of grilling events in county  $c$  where lighter fluid is used
- $EF_{VOC,LF}$  = Emissions factor for VOC from lighter fluid use

These VOC emissions are added to the VOC emissions from grilling meat to determine the total VOC emissions from residential grilling.

$$E_{VOC,c} = E_{VOC,LF,c} + E_{VOC,meat,c} \quad (13)$$

Where:

- $E_{VOC,c}$  = Total emissions of VOC from residential grilling in county  $c$ , in pounds
- $E_{VOC,LF,c}$  = Emissions of VOC from lighter fluid use in county  $c$ , in pounds
- $E_{VOC,meat,c}$  = Emissions of VOC from grilling meat in county  $c$ , in pounds

Emissions of HAPs are calculated by multiplying the total VOC emissions by the speciation factors in Table 1.

$$E_{h,c} = E_{VOC,c} \times EF_h \quad (14)$$

Where:

- $E_{h,c}$  = Emissions of HAP  $h$  in county  $c$ , in pounds
- $E_{VOC,c}$  = Total emissions of VOC from residential grilling in county  $c$ , in pounds
- $EF_h$  = Emissions factor for HAP  $h$

## H. Point Source Subtraction

There are no point source-specific SCCs for residential barbecue grilling; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Sample calculations for estimating VOC emissions from residential grilling in Ada County, ID, are shown in Table 2. Note that equations 1, 2, and 3 result in constant values for each county, so these calculations are not repeated here. See Section C for more information about these equations.

**Table 2. Sample calculations for VOC emissions from residential grilling in Ada County, Idaho**

Eq. #	Equation	Values for Ada County, ID	Result
5	$H_{c,o} = \sum_{units=1}^{units=4} H_{c,t} \times \frac{H_{US,o}}{H_{US,t}}$	138,929 1 – 4 unit homes in Ada County × (154,408 occupied homes in Ada County) /(162,766 Total homes in Ada County)	131,795 occupied homes in Ada County, ID
4	$n_{LF,c} = H_{c,o} \times 3.28$	131,795 occupied homes in Ada County × 3.28 grilling events per home	432,287 grilling events in Ada County, ID
6	$HR_c = \frac{H_{c,o}}{\sum_c H_o}$	$\frac{131,795 \text{ occupied homes in Ada County}}{89,010,502 \text{ homes in U.S.}}$	0.00148 ratio of homes in Ada County, ID
7	$Charcoal_c = HR_c \times Charcoal_{US} \times 2000 \text{ lbs. per ton}$	$0.00148 \times 890,910 \text{ tons charcoal} \times 2000 \text{ lbs. per ton}$	2,638,284.3 pounds charcoal in Ada County, ID
8	$Meat_{charcoal,c} = Charcoal_c \times 0.588$	$2,638,284.3 \text{ lbs. charcoal} \times 0.588$	1,551,311 lbs. meat grilled on charcoal grills in Ada County, ID
9	$Meat_{gas/elec,c} = Meat_{charcoal,c} \times 2.398$	$1,551,311 \text{ lbs. meat} \times 2.398$	3,720,044 lbs. meat grilled on gas or electric grills in Ada County, ID
10	$Meat_{t,c} = Meat_{gas/elec,c} + Meat_{charcoal,c}$	$1,551,311 \text{ lbs. meat} + 3,720,044 \text{ lbs. meat}$	5,271,355 lbs. meat grilled in Ada County, ID
11	$E_{p,c} = \frac{Meat_{t,c}}{2000 \text{ lbs. per ton}} \times EF_{p,meat}$	$\frac{5,271,355 \text{ lbs. meat}}{2000 \text{ lbs. per ton}} \times 1.88 \text{ lbs. per ton}$	4,955 lbs. VOC from grilling meat in Ada County, ID
12	$E_{VOC,LF,c} = n_{LF,c} \times EF_{VOC,LF}$	$432,287 \text{ grilling events} \times 0.02 \text{ lb. per grilling event}$	8,645 lbs. VOC from lighter fluid in Ada County, ID
13	$E_{VOC,c} = E_{VOC,LF,c} + E_{VOC,meat,c}$	$4,955 \text{ lbs. VOC} + 8,645 \text{ lbs. VOC}$	13,601 lbs. VOC from residential grilling in Ada County, ID

## J. Changes from 2014 Methodology

There is one change from the methodology used to estimate the 2014 v2 NEI. In 2014, emissions of CO and NOX were estimated by multiplying an emission factor by the amount of charcoal burned. The EPA reference reports emission factors both in terms of meat and charcoal grilled and in terms of just meat grilled.<sup>10</sup> In order to maintain consistency with the emissions of other criteria pollutants, the 2017 methodology will use the emission factors for meat grilled. As a result, the CO and NOX emissions are estimated by multiplying the amount of meat grilled (rather than the amount of charcoal burned) by the emission factor. EPA maintains the assumption that CO and NOX are generated only by charcoal grills.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. Insufficient data exists to calculate emissions for the counties in the US Virgin Islands, so emissions are based on a proxy county in Florida: 12087, Monroe County. The total emissions in lbs. for this Florida County is divided by its population creating a

lbs.-per-capita emission factor. For each US Virgin Island County, the lbs. per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which serves as the activity data. In these cases, the throughput (activity data) unit and the emissions factor denominator unit are "EACH".

## L. References

- <sup>1</sup> Hearth, Patio and Barbecue Association (HPBA), Statistics/Barbecue Statistics/Charcoal Shipments for 2013. Internet address: <http://www.hpba.org/>, accessed April 2015.
- <sup>2</sup> U.S. Census Bureau. Community Facts, Housing, Selected Housing Characteristics, American Community Survey 5-Year Estimates
- <sup>3</sup> Kingsford email on the weight of their charcoal briquettes 4/11/2015.
- <sup>4</sup> Charcoal Grill Tips from a Real Pro: <http://www.grillingtips.net/charcoal-grill-tips-from-a-real-pro>. Accessed April 2013
- <sup>5</sup> Hearth, Patio and Barbecue Association (HPBA) 3/23/2015 email from Jessica Boothe on how many briquettes to use to cook a pound of meat or chicken.
- <sup>6</sup> Hearth, Patio and Barbecue Association (HPBA), Statistics, BBQ Grill Shipments. Internet Address: <http://www.hpba.org/statistics/barbecue-statistics/CopyofBBQGrillShipments8513.pdf/view>. Accessed April 2015.
- <sup>7</sup> Hearth, Patio & Barbecue Association (HPBA), 2011 State of the Barbecue Industry Report. Internet address: <http://www.hpba.org/media/barbecue-industry/2011-state-of-the-barbecue-industry-report/?searchterm=State%20of%20the%20Barbecue>. Accessed April 2015.
- <sup>8</sup> Hearth, Patio & Barbecue Association (HPBA), 2014 State of the Barbecue Industry Report. Internet address: <http://www.hpba.org/media/barbecue-industry/2014-state-of-the-barbecue-industry-report/?searchterm=2014%20State%20of%20the%20Barbecue%20Industry%20Report>.
- <sup>9</sup> Hearth, Patio and Barbecue Association (HPBA) 3/23/2015 email from Jessica Boothe on how many people with charcoal grills use lighter fluid.
- <sup>10</sup> U.S. Environmental Protection Agency. 1999. Emissions from Street Vendor Cooking Devices (Charcoal Grilling), EPA/600/SR-99/048. <http://www.epa.gov/ttn/catc/dir1/mexfr.pdf>.
- <sup>11</sup> South Coast Air Quality Management District. October 5, 1990. "Rule 1174. "Control of Volatile Organic Compound Emissions from the Ignition of Barbecue Charcoal" accessed May 2015. Internet address: <http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1174.pdf>.
- <sup>12</sup> U.S. Environmental Protection Agency. 2014. SPECIATE Database, version 4.4. Speciation profile 4553, meat charbroiling. Speciation profile was adjusted to be based on VOC, rather than total organic gases (TOG), by removing methane from the profile.

## RESIDENTIAL HEATING – COAL, DISTILLATE OIL, KEROSENE, NATURAL GAS, AND LPG

### A. Source Category Description

Residential heating includes the combustion of fuel, including coal, distillate oil, kerosene, natural gas, and liquefied propane gas (LPG) to heat homes. Common uses of energy associated with this category include space heating, water heating, and cooking. This category does not include the combustion of wood, which is estimated separately.

The general approach to calculating emissions for these SCCs is to take state-level fuel consumption from the EIA State Energy Data System (SEDS)<sup>1</sup> and allocate it to the county level based on data from the Census Bureau on the number of homes in each county that use each fuel type.<sup>2</sup> County-level fuel consumption is multiplied by emissions factors to calculate emissions.

Note that SEDS no longer includes data on residential coal consumption, as it is assumed to be near zero, and therefore emissions will be nonexistent for residential coal consumption. However, the methodology for estimating emissions from coal has been retained if states have additional data on residential coal consumption that they would like to use.

For this source category, the following SCC is assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104001000	Stationary Source Fuel Combustion	Residential	Anthracite Coal	Total: All Combustor Types
2104002000	Stationary Source Fuel Combustion	Residential	Bituminous/ Subbituminous Coal	Total: All Combustor Types
2104004000	Stationary Source Fuel Combustion	Residential	Distillate Oil	Total: All Combustor Types
2104011000	Stationary Source Fuel Combustion	Residential	Kerosene	Total: All Heater Types
2104007000	Stationary Source Fuel Combustion	Residential	Liquefied Petroleum Gas (LPG)	Total: All Combustor Types
2104006000	Stationary Source Fuel Combustion	Residential	Natural Gas	Total: All Combustor Types

### B. Overview of Calculations

The calculations for estimating emissions from residential heating involve distributing state-level energy consumption data from SEDS to each county based on the proportion of houses in that county that use each fuel type as a primary fuel source. Additional calculations are necessary to distribute coal consumption to anthracite or bituminous coal consumption and to distribute fuel oil consumption to distillate fuel oil and kerosene consumption. County-level consumption of each fuel is multiplied by an emissions factor to estimate emissions of criteria air pollutants (CAPs) and hazardous air pollutants (HAPs). Sources of data and calculations for fuel consumed by each fuel type and SEDS data on anthracite and bituminous coal ratios are discussed in section C. The process of allocating fuel consumption to the county level based on housing unit data is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from residential heating is discussed in section G.

### C. Activity Data

The amount of fuel consumed by residential sector in the United States from SEDS<sup>1</sup> is used to estimate emissions for this source category. The relevant fuel codes from SEDS are shown in Table 1.

**Table 1. EIA State Energy Data System Fuel Codes.**

Fuel	SEDS Fuel Code
Coal	CLRCP
Distillate fuel oil	DFRCP
Kerosene	KSRCF
Natural Gas	NGRCP
LPG	LGRCP

The SEDS data do not distinguish between anthracite and bituminous/subbituminous coal consumption estimates. The EIA table “Domestic Distribution of U.S. Coal by Destination State, Consumer, Origin and Method of Transportation”<sup>3</sup> provides state-level residential coal distribution data for 2006 that is used to estimate the fraction of coal consumption that is anthracite and bituminous/subbituminous. The amount of anthracite distributed to each state and the total coal delivered to each state is used to estimate the proportion of anthracite and bituminous coal consumption. Table 2 presents the anthracite and bituminous coal ratios for each state.

**Table 2. Anthracite and Bituminous Coal Distribution for the Residential and Commercial Sectors**

State	Ratio of Bituminous	Ratio of Anthracite	State	Ratio of Bituminous	Ratio of Anthracite
Alabama	1.000	0.000	Montana	1.000	0.000
Alaska	1.000	0.000	Nebraska	1.000	0.000
Arizona	0.814	0.186	Nevada	1.000	0.000
Arkansas	0.814	0.186	New Hampshire	0.000	1.000
California	1.000	0.000	New Jersey	0.000	1.000
Colorado	0.996	0.004	New Mexico	1.000	0.000
Connecticut	0.000	1.000	New York	0.600	0.400
Delaware	0.814	0.186	North Carolina	1.000	0.000
Dist. Columbia	1.000	0.000	North Dakota	1.000	0.000
Florida	0.814	0.186	Ohio	0.873	0.127
Georgia	1.000	0.000	Oklahoma	0.917	0.083
Hawaii	1.000	0.000	Oregon	1.000	0.000
Idaho	0.979	0.021	Pennsylvania	0.194	0.806
Illinois	0.998	0.002	Rhode Island	0.000	1.000
Indiana	0.947	0.053	South Carolina	0.997	0.003
Iowa	0.999	0.001	South Dakota	1.000	0.000
Kansas	1.000	0.000	Tennessee	0.994	0.006
Kentucky	0.998	0.002	Texas	0.814	0.186
Louisiana	1.000	0.000	Utah	1.000	0.000
Maine	0.000	1.000	Vermont	0.000	1.000
Maryland	0.929	0.071	Virginia	0.963	0.037
Massachusetts	0.500	0.500	Washington	1.000	0.000
Michigan	0.667	0.333	West Virginia	0.905	0.095
Minnesota	0.997	0.003	Wisconsin	0.991	0.009
Mississippi	1.000	0.000	Wyoming	1.000	0.000
Missouri	1.000	0.000			

Source: Reference 3

The SEDS data on residential coal consumption are split into consumption of anthracite and bituminous/subbituminous coal based on the ratios in Table 2.

$$FC_{ant/bit,s} = FC_{coal,s} \times R_{ant/bit} \quad (1)$$

Where:

$FC_{ant/bit,s}$	=	anthracite or bituminous coal consumption in state $s$ , in tons
$FC_{coal,s}$	=	total fuel consumption of coal in state $s$ from SEDS, in tons
$R_{ant/bit}$	=	ratio of anthracite or bituminous coal to total coal, as found in Table 2

#### D. Allocation Procedure

State-level fuel consumption is allocated to each county using the US Census Bureau's 5-year estimate Census Detailed Housing Information,<sup>2</sup> which includes the number of housing units using a specific type of fuel for their primary fuel source. State fuel consumption is allocated to each county using the ratio of the number of houses using each fuel in each county to the total number of houses using each fuel in the state.

For most fuels, the fuel type in SEDS matches well to the fuel type used in the Census data. However, the Census data report only for total fuel oil, which does not distinguish between distillate fuel oil and kerosene. Therefore, the ratio of distillate fuel oil versus kerosene in the heating fuel oil mix, which is used to determine the fraction of homes in each county that use distillate and those that use kerosene, is calculated.

$$R_{dfo/ker,s} = \frac{FC_{dfo/ker,s}}{FC_{dfo,s} + FC_{ker,s}} \quad (2)$$

Where:

$R_{dfo/ker,s}$	=	ratio of residential distillate fuel oil or kerosene to total distillate fuel oil and kerosene in state $s$
$FC_{dfo/ker,s}$	=	fuel consumption of distillate fuel oil or kerosene in state $s$ from SEDS, in thousand barrels

Then, the ratio of distillate fuel oil or kerosene to total fuel oil is used to determine how many housing units in each county use distillate fuel oil or kerosene.

$$HU_{dfo/ker,c} = HU_{fo,c} \times R_{dfo/ker,s} \quad (3)$$

Where:

$HU_{dfo/ker,c}$	=	housing units in county $c$ using distillate fuel oil or kerosene as the primary heating fuel
$HU_{fo,c}$	=	housing units in county $c$ using any fuel oil as primary heating fuel

To distribute the state-level energy consumption data for all fuel types, the ratio of county-level housing units using each fuel type as primary heating fuel to state-level housing units using that fuel type is calculated. This ratio is used to distribute state-level fuel consumption to the county level. The county-level values for housing units using distillate oil and kerosene as primary fuel are calculated in equations 2 and 3 above.

$$R_{f,c} = \frac{HU_{f,c}}{HU_{f,s}} \quad (4)$$

Where:

$R_{f,c}$	=	ratio of homes in county $c$ to homes in state $s$ that use fuel $f$ as primary heating fuel
$HU_{f,c}$	=	housing units in county $c$ using fuel type $f$ as primary heating fuel
$HU_{f,s}$	=	housing units in state $s$ using fuel type $f$ as primary heating fuel

The state-level fuel consumption of each fuel type from SEDS is multiplied by the county-level ratio of homes using each fuel type. State-level fuel consumption of anthracite and bituminous/subbituminous coal is calculated in equations 1 and 2 in Section C.

$$FC_{f,c} = FC_{f,s} \times R_{f,c} \quad (5)$$

Where:

- $FC_{f,c}$  = fuel consumption of fuel type  $f$  in county  $c$ , in tons, thousand barrels, or thousand cubic feet  
 $FC_{f,s}$  = fuel consumption of fuel type  $f$  in state  $s$ , in tons, thousand barrels, or thousand cubic feet, from SEDS  
 $R_{f,c}$  = ratio of homes in county  $c$  to homes in state  $s$  that use fuel  $f$  as primary heating fuel

Fuel consumption of distillate fuel oil is converted from barrels to gallons using a conversion factor of 42 gallons per barrel.

## E. Emissions Factors

All emissions factors for CAPs, except ammonia, are from AP-42.<sup>4</sup> The ammonia emissions factor is from EPA's Estimating Ammonia Emissions from Anthropogenic Sources, Draft Final Report.<sup>5</sup> In some cases HAP emissions factors are from a memorandum to EPA called "Baseline Emission Inventory of HAP Emissions from MACT Sources – Interim Final Report".<sup>6</sup>

For many residential heating fuels, the emissions factors for SO<sub>2</sub> and PM species are adjusted using sulfur or ash content data for the fuel at the county level. Note that for coal emissions, this step need only be done if a state supplies data on residential coal consumption, because SEDS currently assumes zero residential coal consumption.

$$EF_{f,s,p} = SAC_{f,s} \times EF_{unadj,f} \quad (6)$$

Where:

- $EF_{x,p}$  = emissions factor of pollutant  $p$  for fuel type  $f$  in state  $s$   
 $SAC_x$  = sulfur or ash content for fuel type  $f$  in state  $s$   
 $EF_{unadj,f}$  = unadjusted emissions factor for fuel type  $f$ , from EPA AP-42

Table 5 presents a summary of the emissions factors for all fuel types for residential heating: anthracite coal, bituminous/subbituminous coal, distillate fuel oil, kerosene, LPG, and natural gas.

For coal combustion, the SO<sub>2</sub> emission factors are based on the sulfur content of the coal burned, and some of the PM emission factors for anthracite coal require information on the ash content of the coal. State-specific coal sulfur contents for bituminous coal are obtained from the EIA's Coal Data Browser and applied at the county level.<sup>7</sup> Bituminous sulfur content data can be found in the Coal Consumption and Quality Data Set, filtered to only account for commercial and institutional sources. For anthracite coal, an ash content value of 13.38% and a sulfur content of 0.89% are applied to all counties except those in New Mexico (ash content 16.61%, sulfur content 0.77%), Washington (ash content 12%, sulfur content 0.9%), and Virginia (ash content 13.38%, sulfur content 0.43%). Table 3 shows the coal SO<sub>2</sub> and PM emissions factors. Table 4 presents the bituminous coal sulfur content values used for each state.

**Table 3. SO<sub>2</sub> and PM Emissions Factors for Residential Anthracite and Bituminous Coal Combustion**

Pollutant	Emissions Factor (lb/ton)	Data Source, AP-42 Table No.
<b>Anthracite Emissions Factors (SCC 2104001000)</b>		
PM-CON	0.08 * % Ash	1.2-3 (stoker)
PM10-FIL	10	1.2-3 (hand-fired)
PM25-FIL	4.6	Fig. 1.2-1 (ratio of PM25/PM10=1.25/2.70=0.46) 0.46*10=4.6

Pollutant	Emissions Factor (lb/ton)	Data Source, AP-42 Table No.
PM10-PRI	10 + 0.08 * % Ash	1.2-3
PM25-PRI	4.6 + 0.08 * % Ash	1.2-3 and Fig 1.2-1
Sulfur Dioxide	39 * % Sulfur	1.2-1 (residential space heater)
<b>Bituminous Emissions Factors (SCC 2104002000)</b>		
PM-CON	1.04 <sup>+</sup>	1.1-5 (stoker)
PM10-FIL	6.2	1.1-4 (hand-fed)
PM25-FIL	3.8	1.1-11 (underfeed stoker)
PM10-PRI	7.24	Sum of FIL and CON
PM25-PRI	4.84	Sum of FIL and CON
Sulfur Dioxide	31 * % Sulfur	1.1-3 (hand-fed)
<sup>+</sup> Emissions factor provided in AP-42 is 0.04 lb/MMBtu. This is multiplied by the conversion factor of 26 MMBtu/ton provided in AP-42 for bituminous coal.		

**Table 4. State-Specific Sulfur Content for Bituminous Coal (SCC 2104002000)**

State	Percent Sulfur Content	State	Percent Sulfur Content
Alabama	0.00	Montana	0.46
Alaska	0.15	Nebraska	0.00
Arizona	0.00	Nevada	0.00
Arkansas	0.00	New Hampshire	0.00
California	0.00	New Jersey	0.00
Colorado	0.31	New Mexico	0.00
Connecticut	0.00	New York	0.00
Delaware	0.00	North Carolina	1.63
District of Columbia	0.51	North Dakota	0.64
Florida	0.00	Ohio	0.88
Georgia	0.00	Oklahoma	0.00
Hawaii	0.00	Oregon	0.00
Idaho	0.00	Pennsylvania	0.83
Illinois	3.21	Rhode Island	0.00
Indiana	2.95	South Carolina	0.00
Iowa	2.60	South Dakota	0.00
Kansas	0.00	Tennessee	0.00
Kentucky	0.71	Texas	0.00
Louisiana	0.00	Utah	0.00
Maine	0.00	Vermont	0.00
Maryland	0.00	Virginia	1.08
Massachusetts	0.00	Washington	0.00
Michigan	0.00	West Virginia	0.00
Minnesota	0.22	Wisconsin	0.78
Mississippi	0.00	Wyoming	0.44
Missouri	3.03		

Source: Reference 7

The emissions factors for CO, VOC, and some HAPs for anthracite coal are the emissions factors provided in AP-42 for bituminous coal. See Table 5 for the reference for each emissions factor. Emission rates for these pollutants are dependent upon combustion efficiency, with the mass of emissions per unit of heat input generally increasing with decreasing unit size. No anthracite emission rates are provided for residential heaters for these pollutants. Therefore,

it was felt that it the AP-42 emission rates from bituminous coal that are derived for smaller hand-fed units, are more appropriate to use than applying anthracite emissions factors derived for much larger boilers.

Note that while AP-42 provides emissions factors for emissions of some metals from coal combustion, these factors are based on tests at controlled and/or pulverized coal boilers. These test conditions are not expected to be a good representation of emission rates for metals from residential heaters, so these pollutants are not included.

For all counties in the United States, the distillate oil consumed by residential combustion is assumed to be No. 2 fuel oil with a heating value of 140,000 Btu per gallon. The SO<sub>2</sub> emissions factor for distillate oil assumes a sulfur content of 500 parts per million (ppm) and is calculated at the county level.<sup>8</sup>

Emissions factors for kerosene are based on the emissions factors for distillate oil, which are multiplied by a factor of 135/140 to convert them for this use. This factor is based on the ratio of the heat content of kerosene (135,000 Btu/gallon) to the heat content of distillate oil (140,000 Btu/gallon).<sup>4</sup> Criteria pollutant and HAP emissions factors are from the same sources discussed above for distillate fuel oil. The distillate sulfur content (500 ppm) is used for kerosene as well.<sup>8</sup>

Pollutant emissions factors for residential LPG are based on the residential natural gas emissions factors. The natural gas emissions factors are converted to LPG emissions factors by multiplying by 96,750 Btu/gallon.

**Table 5. National Criteria and HAP Emissions Factors for All Fuel Types**

Pollutant code	Pollutant Code Description	Bituminous Coal 2104002000		Anthracite Coal 2104001000		Distillate Fuel Oil 2104004000		Kerosene <sup>a</sup> 2104011000		Natural Gas 2104006000		LPG <sup>b</sup> 2104007000	
		Factor numeric value (lb/ton)	Data source (Table)	Factor numeric value (lb/ton)	Data source (Table)	Factor numeric value (lb/ E3GAL)	Data source (Table)	Factor numeric value (lb/E3BBL)	Data source (Table)	Factor numeric value (lb/E6FT3)	Data source (Table)	Factor numeric value (lb/ E3BBL)	Data source (Table)
CO	CARBON MONOXIDE	275	4; 1.1-3	275 <sup>c</sup>	4; 1.1-3	5	4; 1.3-1	202.5	N/A	40	4; 1.4-1	159.60	N/A
NOX	NITROGEN OXIDES	9.1	4; 1.1-3	3	4; 1.2-1	18	4; 1.3-1	729.0	N/A	94	4; 1.4-1	562.80	N/A
PM-CON	PRIMARY PM CONDENSIBLE	See Table 3		See Table 3		1.3	4; 1.3-2	52.7	N/A	0.32	9	1.27	N/A
PM10-PRI	PRIMARY PM10	See Table 3		See Table 3		2.38 <sup>d</sup>		96.4	N/A	0.52	9	2.07	N/A
PM10-FIL	PRIMARY PM10, FILTERABLE	See Table 3		See Table 3		1.08	4; 1.3-7	43.7	N/A	0.2	9	0.80	N/A
PM25-PRI	PRIMARY PM2.5	See Table 3		See Table 3		2.13 <sup>d</sup>		86.3	N/A	0.43	9	1.71	N/A
PM25-FIL	PRIMARY PM2.5, FILTERABLE	See Table 3		See Table 3		0.83	4; 1.3-7	33.6	N/A	0.11	9	0.44	N/A
SO2	SULFUR DIOXIDE	See Table 3		See Table 3		7.1 <sup>e</sup>	4; 1.3-1	287.6 <sup>e</sup>	N/A	0.6	4; 1.4-2	2.390	N/A
VOC	VOLATILE ORGANIC COMPOUNDS	10	4; 1.1-19	10 <sup>c</sup>	4; 1.1-19	0.713	4; 1.3-3	28.4	N/A	5.5	4; 1.4-2	21.91	N/A
121142	2,4-DINITROTOLUENE	2.80E-07	4; 1.1-14										
532274	2-CHLOROACETOPHENONE	7.00E-06	4; 1.1-14										
3697243	5-METHLY CHRYSENE	2.20E-08	4; 1.1-13										
83329	ACENAPHTHENE	5.10E-07	4; 1.1-13	2.20E-05	4; 1.2-5	2.11E-05	4; 1.3-9	8.53E-04	N/A				
208968	ACENAPHTHYLENE	2.50E-07	4; 1.1-13	8.60E-05	4; 1.2-5	2.53E-07	4; 1.3-9	1.02E-05	N/A				
75070	ACETALDEHYDE	5.70E-04	4; 1.1-14			4.92E-03	6	0.199	N/A	1.37E-05	6	5.44E-05	N/A
98862	ACETOPHENONE	1.50E-05	4; 1.1-14										
107028	ACROLEIN	2.90E-04	4; 1.1-14										
NH3	AMMONIA	2	5; III-1	2	5; III-1	1	5; III-1	40.5	N/A	20	5; III-1	1.95	N/A
120127	ANTHRACENE	2.10E-07	4; 1.1-13	2.50E-05	4; 1.2-5	1.22E-06	4; 1.3-9	4.95E-05	N/A				
7440382	ARSENIC					5.62E-04	6	2.28E-02	N/A				
56553	BENZ[A]ANTHRACENE	8.00E-08	4; 1.1-13	7.10E-05	4; 1.2-5	4.01E-06	4; 1.3-9	1.65E-04	N/A				
71432	BENZENE	0.0013	4; 1.1-14			2.14E-04	4; 1.3-9	8.53E-03	N/A	2.21E-03	6	8.78E-03	N/A
50328	BENZO[A]PYRENE	3.80E-08	4; 1.1-13	5.30E-06	4; 1.2-5								
192972	BENZO[E]PYRENE			6.20E-06	4; 1.2-5								
191242	BENZO[G,H,I]PERYLENE	2.70E-08	4; 1.1-13	5.50E-06	4; 1.2-5	2.26E-06	4; 1.3-9	9.10E-05	N/A				
207089	BENZO[K]FLUORANTHRENE			2.50E-05	4; 1.2-5								
100447	BENZYL CHLORIDE	7.00E-04	4; 1.1-14										
7440417	BERYLLIUM					4.214E-04	6	0.017	N/A				
92524	BIPHENYL	1.70E-06	4; 1.1-13										
117817	BIS(2-ETHYLHEXYL) PHTHALATE	7.30E-05	4; 1.1-14										
75252	BROMOFORM	3.90E-05	4; 1.1-14										
7440439	CADMIUM					4.214E-04	6	0.017	N/A				
75150	CARBON DISULFIDE	1.30E-04	4; 1.1-14										
108907	CHLOROBENZENE	2.20E-05	4; 1.1-14										
67663	CHLOROFORM	5.90E-05	4; 1.1-14										
18540299	Chromium (VI)					7.5854e-05		3.07E-03	N/A				
16065831	Chromium III					3.46E-04		0.014	N/A				
218019	CHRYSENE	1.00E-07	4; 1.1-13	8.30E-05	4; 1.2-5	2.38E-06	4; 1.3-9	9.67E-05	N/A				
98828	CUMENE	5.30E-06	4; 1.1-14										
57125	CYANIDE	2.50E-03	4; 1.1-14										
53703	DIBENZO[A,H]ANTHRACENE					1.67E-06	4; 1.3-9	6.83E-05	N/A				
77781	DIMETHYL SULFATE	4.80E-05	4; 1.1-14										
100414	ETHYL BENZENE	9.40E-05	4; 1.1-14										
75003	ETHYL CHLORIDE	4.20E-05	4; 1.1-14										

Pollutant code	Pollutant Code Description	Bituminous Coal 2104002000		Anthracite Coal 2104001000		Distillate Fuel Oil 2104004000		Kerosene <sup>a</sup> 2104011000		Natural Gas 2104006000		LPG <sup>b</sup> 2104007000	
		Factor numeric value (lb/ton)	Data source (Table)	Factor numeric value (lb/ton)	Data source (Table)	Factor numeric value (lb/ E3GAL)	Data source (Table)	Factor numeric value (lb/E3BBL)	Data source (Table)	Factor numeric value (lb/E6FT3)	Data source (Table)	Factor numeric value (lb/ E3BBL)	Data source (Table)
106934	ETHYLENE DIBROMIDE	1.20E-06	4; 1.1-14										
107062	ETHYLENE DICHLORIDE	4.00E-05	4; 1.1-14										
206440	FLUORANTHENE	7.10E-07	4; 1.1-13	1.70E-04	4; 1.2-5	4.84E-06	4; 1.3-9	1.99E-04	N/A	3E-06	4; 1.4-3	1.26E-05	N/A
86737	FLUORENE	9.10E-07	4; 1.1-13	2.50E-05	4; 1.2-5	4.47E-06	4; 1.3-9	1.82E-04	N/A	2.8E-06	4; 1.4-3	1.17E-05	N/A
50000	FORMALDEHYDE	2.40E-04	4; 1.1-14			3.30E-02	4; 1.3-9	1.365	N/A	7.5E-02	4; 1.4-3	0.31	N/A
110543	HEXANE	6.70E-05	4; 1.1-14										
7647010	HYDROGEN CHLORIDE	1.2	4; 1.1-15	1.2 <sup>c</sup>	4; 1.1-15								
7664393	HYDROGEN FLUORIDE	0.15	4; 1.1-15	0.15 <sup>c</sup>	4; 1.1-15								
193395	INDENO[1,2,3-C,D]PYRENE	6.10E-08	4; 1.1-13			2.14E-06	4; 1.3-9	8.53E-05	N/A				
78591	ISOPHORONE	5.80E-04	4; 1.1-14										
7439921	LEAD					1.264E-03	6	0.051	N/A				
7439965	MANGANESE					8.428E-04	6	0.034	N/A				
7439976	MERCURY	8.30E-05	4; 1.1-18	1.30E-04	4; 1.2-7	4.214E-04	6	0.017	N/A				
74839	METHYL BROMIDE	1.60E-04	4; 1.1-14										
74873	METHYL CHLORIDE	5.30E-04	4; 1.1-14										
80626	METHYL METHACRYLATE	2.00E-05	4; 1.1-14										
1634044	METHYL TERT BUTYL ETHER	3.50E-05	4; 1.1-14										
75092	METHYLENE CHLORIDE	2.90E-04	4; 1.1-14										
91203	NAPHTHALENE	1.30E-05	4; 1.1-13	2.20E-04	4; 1.2-5	1.13E-03	4; 1.3-9	0.046	N/A	6.1E-04	4; 1.4-3	2.55E-03	N/A
7440020	NICKEL					4.214E-04	6	0.017	N/A				
198550	PERYLENE			1.20E-06	4; 1.2-5								
85018	PHENANTHRENE	2.70E-06	4; 1.1-13	2.40E-04	4; 1.2-5	1.05E-05	4; 1.3-9	4.27E-04	N/A	1.7E-05	4; 1.4-3	7.11E-05	N/A
108952	PHENOL	1.60E-05	4; 1.1-14										
123386	PROPIONALDEHYDE	3.80E-04	4; 1.1-14										
129000	PYRENE	3.30E-07	4; 1.1-13	1.20E-04	4; 1.2-5	4.25E-06	4; 1.3-9	1.71E-04	N/A	5E-06	4; 1.4-3	2.09E-05	N/A
7782492	SELENIUM					2.107E-03	6	0.085	N/A				
100425	STYRENE	2.50E-05	4; 1.1-14										
127184	TETRACHLOROETHYLENE	4.30E-05	4; 1.1-14										
108883	TOLUENE	2.40E-04	4; 1.1-14										
108054	VINYL ACETATE	7.60E-06	4; 1.1-14										
1330207	XYLENES	3.70E-05	4; 1.1-14										
a. Kerosene emissions factors are based on distillate fuel oil emissions factors, with conversions. See text in section E for more information. b. LPG emissions factors are based on natural gas emissions factors, with conversions. See text in section E for more information. c. Emissions factors for CO, VOC, and some HAPs for anthracite coal are based on emissions factors for bituminous coal. See text in section E for more information. d. Primary PM <sub>25</sub> -PRI and PM <sub>10</sub> -PRI emissions factors are the sum of the emissions factors for the filterable and condensable portions of PM emissions. e. Assumes a sulfur content of 500 ppm. See text in section E for more information.													

## F. Controls

There are no controls assumed for this category.

## G. Emissions

The criteria pollutant and HAP emissions from residential heating are calculated by multiplying the distributed county-level residential fuel consumption by the corresponding emissions factor for each pollutant. The adjusted emissions factors for SO<sub>2</sub> and PM for anthracite and bituminous/subbituminous coal are calculated above in equation 9 in Section E.

$$E_{f,c,p} = FC_{f,c} \times EF_{f,p} \times \frac{1 \text{ ton}}{2000 \text{ lb}} \quad (7)$$

Where:

- $E_{f,c,p}$  = annual emissions of pollutant  $p$  from combustion of fuel type  $f$  in county  $c$ , in tons
- $FC_{f,c}$  = fuel consumption of fuel type  $f$  in county  $c$ , in tons, thousand barrels, or thousand cubic feet, from equation 5
- $EF_{f,p}$  = emissions factor pollutant  $p$  and fuel type  $f$ , in pounds of emissions per unit (tons, thousand barrels, or thousand cubic feet) of fuel consumption, from Table 5

## H. Point Source Subtraction

There are no point source-specific SCCs for residential heating; therefore, point source subtraction is not performed for this category.

## I. Sample Calculations

Table 6 provides sample calculations for CO emissions from residential heating from distillate fuel oil in Allegheny County, PA.

**Table 6. Sample calculations for CO emissions from residential heating from distillate fuel oil in Allegheny County, PA**

Eq. #	Equation	Values for Allegheny County, PA	Result
1	$FC_{anth/bit,s} = FC_{coal,s} \times R_{anth/bit}$	N/A	This example is for distillate. Equation 1 is for coal.
2	$R_{dfo/ker,s} = \frac{FC_{dfo/ker,s}}{FC_{dfo,s} + FC_{ker,s}}$	$\frac{15,062 \text{ thousand barrels}}{(15,062 \text{ thousand barrels} + 238 \text{ thousand barrels})}$	0.9844 ratio of DFO to total fuel oil
3	$HU_{dfo/ker,c} = HU_{fo,c} \times R_{dfo/ker,s}$	$8,081 \text{ houses} \times 0.9844$	7,955.30 houses using DFO in Allegheny County, PA
4	$R_{f,c} = \frac{HU_{f,c}}{HU_{f,s}}$	$\frac{7,955.30 \text{ houses}}{916,301.2 \text{ houses}}$	0.0086 county housing allocation ratio for Allegheny County, PA

Eq. #	Equation	Values for Allegheny County, PA	Result
5	$FC_{f,c}$ $= FC_{f,s} \times R_{f,c}$ $\times 42 \text{ gal. per barrel}$	15,062 thous. barrels $\times$ 0.0086 $\times$ 42 gal. per barrel	5,492.25 thousand gallons DFO consumed in Allegheny County, PA
6	$EF_{anth/bit,s,p} = SAC_{f,s}$ $\times EF_{unadj,f}$	N/A	This example is for distillate. Equation 6 is for coal.
7	$E_{f,c,p} = FC_{f,c} \times EF_{f,p} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$	5,492.25 thous. gal. $\times$ 5 lbs. per thous. gal $\times \frac{1 \text{ ton}}{2000 \text{ lb}}$	13.7 tons CO from DFO in Allegheny County, PA

## J. Changes from 2014 Methodology

The 2017 methodology used a lower sulfur content value of 500 ppm for distillate fuel oil and kerosene compared to the value of 3% used in the 2014 methodology.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

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## ROAD DUST

### A. Source Category Description

The road dust category includes emissions of particulate matter from vehicles driving over paved and unpaved roads. In 2014 the PM<sub>25</sub>-PRI emissions from paved and unpaved roads were 177,862 tons and 659,625 tons, respectively.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2294000000	Mobile Sources	Paved Roads	All Paved Roads	Total: Fugitives
2296000000	Mobile Sources	Unpaved Roads	All unpaved Roads	Total: Fugitives

### B. Overview of Calculations

Emissions from road dust are calculated based on the number of vehicle miles traveled (VMT) on paved or unpaved roads in each county multiplied by an emission factor calculated for each county. Sources of data and calculations for VMT are discussed in section C. The methods for calculating the emissions factors are discussed in section E. The estimation of emissions from road dust is discussed in section G.

### C. Activity Data

Generally, VMT on US roads can be obtained from the Federal Highway Administration (FHWA). FHWA categorizes roads into 14 different types based on road function and access; these road types can be found in Table 1. However, FHWA only provides VMT for each road type at the state-level, so county-level values must be calculated in order to estimate county-level emissions.

**Table 1. FHWA Road Types**

FHWA Road Type
Rural Interstate
Rural Other Freeways and Expressways
Rural Other Principal Arterial
Rural Minor Arterial
Rural Major Collector
Rural Minor Collector
Rural Local
Urban Interstate
Urban Other Freeways and Expressways
Urban Other Principal Arterial
Urban Major Collector
Urban Minor Collector
Urban Local
Urban Minor Arterial

Total VMT in each county is available for four road types from EPA's MOTO Vehicle Emission Simulator (MOVES) model. The road types used in MOVES are different from the 14 road types used by FHWA, so the crosswalk shown in Table 2 was used to estimate VMT on the FHWA road types. VMT data for 2017 are not yet available from MOVES, so 2016 data are used as a proxy.

**Table 2. Crosswalk from MOVES road type to FHWA road type**

MOVES Road Type	FHWA Road Type
Rural Restricted Access	Rural Interstate
Rural Restricted Access	Rural Other Freeways and Expressways
Rural Unrestricted Access	Rural Other Principal Arterial
Rural Unrestricted Access	Rural Minor Arterial
Rural Unrestricted Access	Rural Major Collector
Rural Unrestricted Access	Rural Minor Collector
Rural Unrestricted Access	Rural Local
Urban Restricted Access	Urban Interstate
Urban Restricted Access	Urban Other Freeways and Expressways
Urban Unrestricted Access	Urban Other Principal Arterial
Urban Unrestricted Access	Urban Major Collector
Urban Unrestricted Access	Urban Minor Collector
Urban Unrestricted Access	Urban Local
Urban Unrestricted Access	Urban Minor Arterial

In order to calculate county-level VMT on FHWA road types, the VMT for each MOVES road type in each county is split up into the FHWA road types using ratios based on state-level FHWA data.<sup>1</sup> The state-level ratio is calculated as the total state-level VMT for each road type, divided by the sum of the state-level VMT for all other road types that match to the same MOVES road type shown in the crosswalk in Table 2. For example, in the crosswalk, the MOVES road type “Rural Restricted Access” corresponds to the FHWA road types “Rural Interstate” and “Rural Other Freeways and Expressways.” To estimate the VMT on Rural Interstates in a given county, the county-level VMT on Rural Restricted Access Roads is multiplied by the ratio of state-level VMT on Rural Interstates divided by the sum of state-level VMT on Rural Interstates and Rural Other Freeways and Expressways.

$$VMT_{t,c,r} = VMT_{t,c,mr} \times \frac{VMT_{t,s,r}}{\sum_{r=1}^R VMT_{t,s,r}} \quad (1)$$

Where:

- $VMT_{t,c,r}$  = Total (paved and unpaved) vehicle miles traveled in county  $c$  on FHWA road type  $r$
- $VMT_{t,c,mr}$  = Total (paved and unpaved) vehicle miles traveled in county  $c$  on MOVES road type  $mr$
- $VMT_{t,s,r}$  = Total (paved and unpaved) vehicle miles traveled in state  $s$  on FHWA road type  $r$

MOVES provides data on total VMT, but it does not provide data how much of that VMT is on paved or unpaved roads. FHWA provides state-level data on the amount of VMT on paved and unpaved roads in 2016 for most road types, with the exception of three: Rural Local, Urban Local, and Rural Minor Collector.<sup>2</sup> To determine how much of the total VMT is on paved or unpaved roads, the total VMT in each county is multiplied by the ratio of state-level VMT on paved or unpaved roads to total state-level VMT on each road type.

$$VMT_{p/u,c,r} = VMT_{t,c,r} \times \frac{VMT_{p/u,s,r}}{VMT_{t,s,r}} \quad (2)$$

Where:

- $VMT_{p/u,c,r}$  = Paved or unpaved vehicle miles traveled in county  $c$  on FHWA road type  $r$
- $VMT_{t,c,r}$  = Total vehicle miles traveled in county  $c$  on FHWA road type  $r$ , from equation 1
- $VMT_{p/u,s,r}$  = Paved or unpaved vehicle miles traveled in state  $s$  on FHWA road type  $r$

Because paved and unpaved VMT data were unavailable from FHWA for 2016 for the Rural Local, Urban Local, and Rural Minor Collector road types, ratios for those road types were developed using state-level results from a

2008 model run from the National Mobile Inventory Model (NMIM), a precursor to MOVES. To account for the fact that some states have paved many of their unpaved roads since 2008, an adjustment factor was developed based on the change in unpaved road length. While FHWA does not provide 2016 data on paved or unpaved VMT for those three road types, it does provide 2016 data on paved and unpaved road *length* for these road types.<sup>3</sup> The adjustment factor is based on the change in the ratio of paved or unpaved road *length* 2016 to the ratio in 2008.

$$AF_{p/u,r,s} = \frac{\frac{Length_{p/u,s,r,2016}}{Length_{t,s,r,2016}}}{\frac{Length_{p/u,s,r,2008}}{Length_{t,s,r,2008}}} \quad (2a)$$

Where:

- $AF_{p/u,s,r}$  = Adjustment factor for paved or unpaved vehicle miles traveled in state  $s$  on FHWA road type  $r$
- $Length_{p/u,s,r,2016}$  = Paved or unpaved road length in state  $s$  for FHWA road type  $r$  in 2016
- $Length_{t,s,r,2016}$  = Total road length in state  $s$  for FHWA road type  $r$  in 2016
- $Length_{p/u,s,r,2008}$  = Paved or unpaved road length in state  $s$  for FHWA road type  $r$  in 2008
- $Length_{t,s,r,2008}$  = Total road length in state  $s$  for FHWA road type  $r$  in 2008

This adjustment factor is multiplied by the paved or unpaved VMT ratio from NMIM for Rural Local, Urban Local, and Rural Minor Collector roads.

$$VMT_{p/u,c,r} = VMT_{t,c,r} \times \frac{VMT_{p/u,s,r}}{VMT_{t,s,r}} \times AF_{p/u,s,r} \quad (2b)$$

Where:

- $VMT_{p/u,c,r}$  = Paved or unpaved vehicle miles traveled in county  $c$  on FHWA road type  $r$
- $VMT_{t,c,r}$  = Total vehicle miles traveled in county  $c$  on FHWA road type  $r$ , from equation 1
- $VMT_{p/u,s,r}$  = Paved or unpaved vehicle miles traveled in state  $s$  on FHWA road type  $r$  (from NMIM)
- $VMT_{t,s,r}$  = Total vehicle miles traveled in state  $s$  on FHWA road type  $r$
- $AF_{p/u,s,r}$  = Adjustment factor for paved or unpaved vehicle miles traveled in state  $s$  on FHWA road (from equation 2a)

As an example, if a state paved many of its unpaved roads between 2008 and 2016, then the adjustment factor for unpaved roads would be less than 1, reducing the estimated ratio of unpaved VMT to total VMT (and, therefore, increasing the ratio of paved VMT to total VMT).

In addition, it is assumed that there is no VMT on unpaved roads for urban road types.

#### D. Allocation Procedure

The total VMT used to estimate emissions from road dust is available at the county level. The amount of paved and unpaved VMT in each county is estimated using state-level ratios, as described in section C.

#### E. Emissions Factors

The emissions factors for both paved and unpaved roads are calculated at the county level using two separate equations from AP-42.<sup>4</sup> The emissions factor equations for paved and unpaved roads are described in the sections below. For both paved and unpaved roads, it is assumed that there are no condensable PM emissions and that the primary PM emissions are equal to the filterable PM emissions.

##### Paved Roads

The equation for the emission factor for paved roads is based on the road surface silt loading, the average weight of vehicles traveling the road, and a particle size multiplier for PM25 or PM10.

The road surface silt loading is a function of the average daily traffic volume (ADTV). Table 3 shows the assumed road surface silt loading (g/m<sup>2</sup>) for each FHWA road type for different ADTV ranges.

**Table 3. Assumed silt loading by road type (g/m<sup>2</sup>) based on average daily traffic volume.**

FHWA Road Type	ADTV Range			
	0-499	500-4999	5000-9999	10000+
Rural Interstate	0.015	0.015	0.015	0.015
Rural Other Freeways and Expressways	0.015	0.015	0.015	0.015
Rural Other Principal Arterial	0.6	0.2	0.06	0.03
Rural Minor Arterial	0.6	0.2	0.06	0.03
Rural Major Collector	0.6	0.2	0.06	0.03
Rural Minor Collector	0.6	0.2	0.06	0.03
Rural Local	0.6	0.2	0.06	0.03
Urban Interstate	0.015	0.015	0.015	0.015
Urban Other Freeways and Expressways	0.015	0.015	0.015	0.015
Urban Other Principal Arterial	0.6	0.2	0.06	0.03
Urban Minor Arterial	0.6	0.2	0.06	0.03
Urban Major Collector	0.6	0.2	0.06	0.03
Urban Minor Collector	0.6	0.2	0.06	0.03
Urban Local	0.6	0.2	0.06	0.03

Source: AP-42, Section 13.2.1, Table 13.2.1-2

The ADTV is calculated based on state-level VMT on paved roads divided by the state-level road length of that road type, from FHWA<sup>3</sup> multiplied by 365 days.

$$ADTV_{p,s,r} = \frac{VMT_{p,s,r}}{Length_{p,s,r} \times 365} \quad (3)$$

Where:

$ADTV_{p,s,r}$  = Average daily traffic volume on paved roads in state  $s$  on road type  $r$   
 $VMT_{p,s,r}$  = Vehicle miles traveled on paved roads in state  $s$  on road type  $r$   
 $Length_{p,s,r}$  = Length of paved roads in state  $s$  for road type  $r$

The paved road emissions factor is also a function of the average weight of vehicles traveling on each road type in each county. Data from EPA's MOVES model includes the estimated VMT on each road type in each county from each of the vehicle types listed in Table 4. The VMT from each vehicle type and the estimated mass of each vehicle type are used to develop a weighted average of the weight of vehicles traveling over each road type in each county. The weighted average is based on the sum of the VMT for each vehicle type and road type in each county, divided by the total VMT across all vehicle types for each road type in each county, multiplied by the estimated mass for each vehicle type.

$$W_{c,r} = \sum_{v=1}^V \left( m_v \times \frac{VMT_{c,r,v}}{VMT_{c,r}} \right) \quad (4)$$

Where:

- $W_{c,r}$  = Weighted average weight of vehicles traveling over road type  $r$  in county  $c$
- $m_v$  = Estimated mass of vehicle type  $v$ , from Table 3
- $VMT_{c,r,v}$  = Vehicle miles traveled by vehicle type  $v$  on road type  $r$  in county  $c$ , from MOVES
- $VMT_{c,r}$  = Vehicle miles traveled across all vehicle types on road type  $r$  in county  $c$ , from MOVES

**Table 4. Estimated mass of vehicles included in MOVES.**

MOVES Vehicle Type	Estimated Mass (tons)
Motorcycle	0.3
Passenger Car	1.5
Passenger Truck	1.9
Light Commercial Truck	2.1
Intercity Bus	19.6
Transit Bus	16.6
School Bus	9.1
Refuse Truck	23.1
Single Unit Short-haul Truck	8.5
Single Unit Long-haul Truck	7.0
Motor Home	7.5
Combination Short-haul Truck	23.0
Combination Long-haul Truck	24.6

Source: EPA MOVES SourceUseTypePhysics Table, provided to Abt Associates by David Brzezinski, EPA OTAQ

The emission factor for emissions from dust from paved roads is also a function of a particle size multiplier, to determine the emissions from either PM10 or PM25 (Table 4).

**Table 5. Particle size multiplier for paved roads.**

Pollutant	Particle Size Multiplier (g/VMT)
PM10	1
PM25	0.25

Source: AP-42, Section 13.2.1, Table 13.2.1-1

The emission factor for road dust from paved roads comes from AP-42 and is based on multiplying the particle size multiplier, the silt loading content, and the average weight of vehicles.

$$EF_{p,c,r,PM25/PM10} = k_{PM25/PM10} \times (sL_{c,r})^{0.91} \times (W_{c,r})^{1.02} \quad (5)$$

Where:

$EF_{p,c,r,PM10/PM25}$	=	Emission factor for either PM10 or PM25 for paved roads on road type $r$ in county $c$ , (g/VMT)
$k_{PM10/PM25}$	=	Particle size multiplier for either PM10 or PM25, from Table 4, (g/VMT)
$sL_{c,r}$	=	Road surface silt loading from road type $r$ in county $c$ , (g/m <sup>2</sup> )
$W_{c,r}$	=	Average weight of vehicles traveling over road type $r$ in county $c$ , (tons)

### Unpaved Roads

The emission factor for unpaved roads is from AP-42 and is based on a particle size multiplier; the surface material silt content; the mean vehicle speed; the surface material moisture content; and an emission factor for vehicle fleet exhaust, brake wear, and tire wear.

The particle size multiplier and the emission factor for exhaust, brake wear, and tire wear are taken from AP-42 and are shown in Table 5.

**Table 6. Particle size multiplier and emission factor for exhaust, break wear, and tire wear for unpaved roads.**

Constant	PM25	PM10
Particle size multiplier	0.18	1.8
Emission factor for exhaust, break wear, and tire wear	0.00036	0.00047

*Source: AP-42, Section 13.2.2, Tables 13.2.2-2 and 13.2.2-4*

Average State-level unpaved road silt content values, developed as part of the 1985 NAPAP Inventory, were obtained from the Illinois State Water Survey.<sup>5</sup> Silt contents of over 200 unpaved roads from over 30 States were obtained. Average silt contents of unpaved roads were calculated for each state that had three or more samples for that State. For States that did not have three or more samples, the average for all samples from all States was used as a default value. The silt content values are by State, and identifies if the values were based on a sample average or default value. The values for each state are shown in Table 6.

**Table 7 Surface material silt content values (%) for unpaved roads in each state.**

State	Surface Material Silt Content (%)	State	Surface Material Silt Content (%)	State	Surface Material Silt Content (%)	State	Surface Material Silt Content (%)
AL	3.9	IL	2.6	MT	6.6	RI	3.9
AK	3.8	IN	2.6	NE	4.2	SC	3.9
AZ	3	IA	2.5	NV	1.7	SD	3.1
AR	3.9	KS	3.9	NH	3.9	TN	2
CA	2.6	KY	3.9	NJ	3.9	TX	5.6
CO	1.5	LA	3.9	NM	4.3	UT	3.9
CT	3.9	ME	3.9	NY	4.7	VT	3.9
DE	3.9	MD	3.9	NC	5.1	VA	3.2
DC	3.9	MA	3.9	ND	3.9	WA	3.9
FL	3.9	MI	2.6	OH	3.1	WV	3.9
GA	3.9	MN	2.7	OK	4.4	WI	4.2
HI	3.8	MS	3.9	OR	7.2	WY	7.1
ID	3.9	MO	6.5	PA	3.3		

Table 7 lists the speeds modeled on the unpaved roads by roadway class. These speeds were determined based on the average speeds modeled for on-road emission calculations and weighted to determine a single average speed for each of the roadway classes. The roadway class “Urban collector” with an average speed of 20 mph was split into two sub-categories, “Urban major collector” and “Urban minor collector”, to correspond to the roadway types found in the 2014 VMT data. Other FHWA road types not listed in Table 7 are assumed to have no VMT on unpaved roads. Although for the EPA emissions estimates it was assumed that there is no urban unpaved VMT, the speeds in Table 7 for urban road types are presented in the event an SLT program wishes to use them to estimate unpaved emissions on urban road types.

**Table 8. Speeds modeled by roadway type on Unpaved Roads.**

FHWA Road Type	Average Speed (mph)
Rural Minor Arterial	39
Rural Major Collector	34
Rural Minor Collector	30
Rural Local	30
Urban Other Principal Arterial	20
Urban Minor Arterial	20
Urban Major Collector	20
Urban Minor Collector	20
Urban Local	20

A report by Cowherd et al.<sup>6</sup> estimates a range of 0.3% to 1.1% for surface material moisture content. EPA used expert judgment to assign surface material moisture content values to counties based on regional patterns of soil moisture and precipitation.

The equation for the emission factor for emissions from unpaved road dust is shown below.

$$EF_{u,c,r,PM25/PM10} = \frac{k_{PM25/PM10} \times (silt_s/12) \times (speed_r/30)^{0.5}}{\left(\frac{M_c}{0.5}\right)^{0.2}} - C_{PM25/PM10} \quad (6)$$

Where:

- $EF_{u,c,r, PM25/PM10}$  = Emission factor for either PM10 or PM25 for unpaved roads on road type  $r$  in county  $c$ , (lb/VMT)
- $k_{PM25}$  = Particle size multiplier for either PM10 or PM25, from Table 5
- $silt_s$  = Surface material silt content (%) for unpaved roads in state  $s$ , from Table 6
- $speed_r$  = Average speed traveled (mph) on road type  $r$
- $M_c$  = Average surface material moisture content (%) in county  $c$
- $C_{PM25/PM10}$  = Emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear (lb/VMT)

## F. Controls

Controls were applied for both paved and unpaved road dust emissions for counties in nonattainment for PM10.

Paved road dust controls were applied by county to urban and rural roads in serious PM10 nonattainment areas and to urban roads in moderate PM10 nonattainment areas. The assumed control measure is vacuum sweeping of paved roads twice per month. A control efficiency of 79 percent was assumed for this control measure.<sup>7</sup> The assumed rule penetration varies by roadway class and PM<sub>10</sub> nonattainment area classification (serious or moderate).<sup>7</sup> The rule

penetration rates are shown in Table 8. Rule effectiveness was assumed to be 100% for all counties where this control was applied.

Note that the controls were applied at the county/roadway class level, and the controls differ by roadway class. No controls were applied to interstate or principal arterial roadways because these road surfaces typically do not have vacuum sweeping. In the excel spreadsheet, the total emissions for all roadway classes were summed to the county level. Therefore, the emissions at the county level can represent several different control efficiency and rule penetration levels, and may include both controlled and uncontrolled emissions in the composite value.

**Table 9. Penetration rate of paved road vacuum sweeping for control of dust emissions from paved roads.**

<b>PM10 Nonattainment Status</b>	<b>Roadway Class</b>	<b>Vacuum Sweeping Penetration Rate</b>
Moderate	Urban Freeway & Expressway	0.67
Moderate	Urban Minor Arterial	0.67
Moderate	Urban Collector	0.64
Moderate	Urban Local	0.88
Serious	Rural Minor Arterial	0.71
Serious	Rural Major Collector	0.83
Serious	Rural Minor Collector	0.59
Serious	Rural Local	0.35
Serious	Urban Freeway & Expressway	0.67
Serious	Urban Minor Arterial	0.67
Serious	Urban Collector	0.64
Serious	Urban Local	0.88

For rural unpaved roads in serious PM10 nonattainment areas, it was assumed that chemical stabilization was applied, with a control efficiency of 75 percent and a rule penetration of 50 percent. In counties currently at maintenance status, controls were assumed based on the severity (moderate or serious) of their prior nonattainment status. Some counties had multiple partial areas with differing levels of nonattainment. In these cases, controls were assumed to be applied based on the most serious level of nonattainment found within a given county.

In addition, for both paved and unpaved roads, after controls were applied, a meteorological adjustment was applied. The meteorological adjustment accounts for the fact that will be wet after it rains and resulting in significantly lower dust emissions. The county-level meteorological adjustment factors were developed by EPA based on the ratio of the unadjusted NEI2014 version 1 emissions to the adjusted emissions in each county after the emissions were processed to create the SMOKE flat files. The county-level meteorological adjustment is a number between 0 and 1 that is multiplied by the estimated emissions.

## G. Emissions

The emissions from paved and unpaved road dust are calculated by multiplying the VMT for each road type in each county for paved or unpaved roads by the corresponding emission factor. Emissions are then summed across road types to determine the total PM10 or PM25 emissions from paved or unpaved roads in each county.

$$E_{p/u,c,PM25/PM10} = \sum_{r=1}^R VMT_{p/u,c,r} \times EF_{p/u,c,r,PM25/PM10} \times (1 - CE_c) \times Met_c \quad (7)$$

Where:

$E_{p/u,c,PM25/PM10}$	=	Emissions of either PM10 or PM25 from paved or unpaved roads in county $c$
$VM_{p/u,c,r}$	=	Paved or unpaved vehicle miles traveled in county $c$ on FHWA road type $r$
$EF_{p/u,c,r,PM25/PM10}$	=	Emission factor for either PM10 or PM25 for paved or unpaved roads on road type $r$ in county $c$ , (lb/VMT)
$CE_c$	=	Control efficiency for county $c$
$Met_c$	=	Meteorological adjustment for county $c$

## H. Point Source Subtraction

There are no point source-specific SCCs for road dust; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 9 shows the sample calculations for PM25-PRI emissions from paved and unpaved road dust on rural local roads in Autauga County, Alabama. The steps shown in the table below are repeated for all road types and summed to the county level to determine the total PM25 and PM10 emissions in each county from paved and unpaved roads.

**Table 10. Sample calculations for PM25-PRI emissions from paved and unpaved road dust on rural local roads in Autauga County, Alabama.**

Eq. #	Equation	Values for Autauga County, AL	Result
1	$VMT_{t,c,r} = VMT_{t,c,mr} \times \frac{VMT_{t,s,r}}{\sum_{r=1}^R VMT_{t,s,r}}$	244 million VMT rural unrestricted access roads in Autauga from MOVES $\times$ $\left( \frac{7,036 \text{ million VMT on rural local roads in AL from FHWA}}{22,802 \text{ million VMT on all rural unrestricted access roads in AL from FHWA}} \right)$	75.6 million VMT on rural local roads in Autauga County
2a	$AF_{p/u,r,s} = \frac{\frac{Length_{p/u,s,r,2016}}{Length_{t,s,r,2016}}}{\frac{Length_{p/u,s,r,2008}}{Length_{t,s,r,2008}}}$	$\frac{20,773 \text{ miles unpaved rural local roads in AL in 2016}}{49,416 \text{ miles total rural local roads in AL in 2016}} \times \frac{22,164 \text{ miles unpaved rural local roads in AL in 2008}}{50,461 \text{ miles total rural local roads in AL in 2008}}$	Adjustment factor of 0.96 to be multiplied by unpaved VMT ratio for rural local roads
2b	$VMT_{p/u,c,r} = VMT_{t,c,r} \times \frac{VMT_{p/u,s,r}}{VMT_{t,s,r}} \times AF_{p/u,s,r}$	$75.6 \text{ million VMT} \times \frac{797 \text{ million unpaved rural local VMT in AL from NMIM}}{6.7 \text{ billion total rural local VMT in AL from NMIM}} \times 0.96$	8.6 million unpaved VMT on rural local roads in Autauga County
3	$ADTV_{p,s,r} = \frac{VMT_{p,s,r}}{Length_{p,s,r} \times 365}$	$\frac{5.9 \text{ billion paved rural local VMT in AL}}{28,643 \text{ miles paved rural local roads in AL} \times 365}$	564 miles average daily traffic volume on rural local roads
4	$W_{c,r} = \sum_{v=1}^v \left( m_v \times \frac{VMT_{c,r,v}}{VMT_{c,r}} \right)$	$1.5 \text{ tons per passenger car} \times \left( \frac{96 \text{ million VMT from passenger cars}}{244 \text{ million total VMT}} \right)$	This is repeated and summed across all vehicle types. The weighted average for Autauga County is 3.4 tons.
5	$EF_{p,c,r,PM25/PM10} = k_{PM25/PM10} \times (sL_{c,r})^{0.91} \times (W_{c,r})^{1.02}$	$0.25 \text{ g/VMT} \times (0.2 \text{ g/m}^2)^{0.91} \times 3.4 \text{ tons}^{1.02}$	0.2 g PM25/ VMT on paved rural local roads in Autauga County
6	$EF_{u,c,r,PM25/PM10} = \frac{k_{PM25} \times (silt_s/12) \times (speed_r/30)^{0.5}}{\left( \frac{M_c}{0.5} \right)^{0.2}} - C_{PM25/PM10}$	$\frac{0.18 \text{ lb/VMT} \times 3.9\%/12 \times (30\text{mph}/30)^{0.5}}{\left( \frac{1.1\%}{0.5} \right)^{0.2}} - 0.00036 \text{ lb/VMT}$	0.05 lb PM25/ VMT on unpaved rural local roads in Autauga County

Eq. #	Equation	Values for Autauga County, AL	Result
7	$E_{p/u,c,PM25/PM10} = \sum_{r=1}^R VMT_{p/u,c,r} \times EF_{p/u,c,r,PM25/PM10} \times (1 - CE_c) \times Met_c$	<p>76 million VMT on paved rural local roads <math>\times 0.2 \frac{g}{VMT}</math>  <math>\times (1 - 0\% \text{ control efficiency})</math>  <math>\times 0.67 \text{ met adjustment factor}</math></p> <p>8.6 million VMT on unpaved rural local roads <math>\times 0.05 \frac{lbs}{VMT}</math>  <math>\times (1 - 0\% \text{ control efficiency})</math>  <math>\times 0.67 \text{ met adjustment factor}</math></p>	<p>10.2 million g PM25-PRI (11 tons) from paved rural local roads in Autauga County.</p> <p>288,100 lbs. PM25-PRI (144 tons) from unpaved rural local roads in Autauga County.</p>

## **J. Changes from 2014v2 Methodology**

The largest change from the methodology used to calculate the 2014v2 NEI emissions from road dust is the method used to determine the VMT on paved and unpaved roads in each county. Both the methods for the 2014v2 and 2017 NEI used the 2008 NMIM run as the starting point for estimating the ratio of VMT on paved or unpaved roads. However, in 2014v2, the estimated VMT on unpaved roads were redistributed within Census regions, to smooth out sharp differences in emissions across state lines. This redistribution is not done for the 2017 NEI.

Similarly, in the 2014v2 NEI, emissions from unpaved roads were also redistributed within states based on proportion of rural population. The goal of this redistribution was to move emissions from unpaved roads out of cities into rural areas where unpaved roads are more likely to occur. This redistribution is not done for the 2017 NEI. Moreover, for the 2017 NEI, it is assumed that urban road types do not have emissions from unpaved roads. This assumption was not made for the 2014v2 NEI.

There was one adjustment to the method used to estimate the emission factor for unpaved roads. In the 2014v2 NEI, a default surface material moisture content of 0.5% was applied for all counties. In the 2017 NEI, counties are assigned surface material moisture contents of either 0.3% or 1.1%, depending on regional patterns of soil moisture and precipitation. There were no changes to the method used to estimate the emission factor for paved roads.

## **K. Puerto Rico and U.S. Virgin Islands Emissions Calculations**

Since insufficient data exist to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emissions factor. For each Puerto Rico and US Virgin Island county, the tons per capita emissions factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## **L. References**

<sup>1</sup> Federal Highway Administration, "Highway Statistics, 2016." Table VM-2.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2016/>

<sup>2</sup> Data provided to Abt Associates by Robert Rozycki, FHWA.

<sup>3</sup> Federal Highway Administration, "Highway Statistics, 2016." Table HM-51.  
<https://www.fhwa.dot.gov/policyinformation/statistics/2016/>

<sup>4</sup> United States Environmental Protection Agency, Office of Air Quality Planning and Standards. Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Sections 13.2.1, Paved Roads, and 13.2.2, Unpaved Roads. Research Triangle Park, NC. January 2011

<sup>5</sup> W. Barnard, G. Stensland, and D. Gatz. 1987. Illinois State Water Survey, "Evaluation of Potential Improvements in the Estimation of Unpaved Road Fugitive Emission Inventories," paper 87-58.1, presented at the 80th Annual Meeting of the APCA. New York, New York. June 21-26, 1987.

<sup>6</sup> Cowherd, C., M.A. Grelinger, C. Kies, and T.G. Pace. 2002. Improved Activity Levels for National Emission Inventories of Fugitive Dust from Paved and Unpaved Roads. Presentation at 11<sup>th</sup> International Emission Inventory Conference. Atlanta, Georgia, April 15-18, 2002.

<sup>7</sup> E.H. Pechan & Associates, Inc. 1995. "Phase II Regional Particulate Strategies; Task 4: Particulate Control Technology Characterization," draft report prepared for U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. Washington, DC.

## RESIDENTIAL WOOD COMBUSTION

### A. Source Category Description

Residential wood combustion (RWC) appliances, such as fireplaces, fireplace inserts, woodstoves, and hydronic heaters, are significant sources of air pollution in the United States—especially during winter months. RWC emits large amounts of fine particulate matter (PM<sub>2.5</sub>-PRI), volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) that are known to contribute to poor human health, air quality, and visibility. In 2017 RWC appliances are estimated to have emitted more than 300,000 tons of PM<sub>2.5</sub>-PRI. To improve estimates in this sector, the EPA, along with the Commission on Environmental Cooperation (CEC), the Northeast States for Coordinated Air Use Management (NESCAUM), and Abt Associates, conducted a national survey of wood-burning activity in 2018. The results of this survey were used to estimate county-level burning activity, as discussed in more detail below.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2104008100	Stationary Source Fuel Combustion	Residential	Wood	Fireplace: general
2104008210	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; non-EPA certified
2104008220	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; non-catalytic
2104008230	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: fireplace inserts; EPA certified; catalytic
2104008310	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, non-EPA certified
2104008320	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, non-catalytic
2104008330	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: freestanding, EPA certified, catalytic
2104008400	Stationary Source Fuel Combustion	Residential	Wood	Woodstove: pellet-fired, general
2104008510	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, cordwood-fired, non-EPA certified
2104008530	Stationary Source Fuel Combustion	Residential	Wood	Furnace: Indoor, pellet-fired, general
2104008610	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: outdoor
2104008620	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: indoor
2104008630	Stationary Source Fuel Combustion	Residential	Wood	Hydronic heater: pellet-fired
2104008700	Stationary Source Fuel Combustion	Residential	Wood	Outdoor wood burning device, NEC (fire-pits, chimneas, etc)
2104009000	Stationary Source Fuel Combustion	Residential	Firelog	Total: All Combustor Types

## B. Overview of Calculations

The activity data for this category is the amount of wood burned in each county, which is based on data from the CEC survey on the fraction of homes in each county that use each wood-burning appliance and the average amount of wood burned in each appliance.<sup>1</sup> These assumptions are used with the number of occupied homes in each county to estimate the total amount of wood burned in each county, in cords for cordwood appliances and tons for pellet appliances. Cords of wood are converted to tons using county-level density factors from the U.S. Forest Service.<sup>2</sup> Emissions are calculated by multiplying the tons of wood burned by emissions factors. Sources of data and calculations for the amount of wood burned are discussed in section C. Emissions factors are discussed in section E. The estimation of emissions from RWC is discussed in section G.

## C. Activity Data

The activity data for RWC relies on assumptions developed from the CEC survey. The survey received 2,984 responses, and it asked questions about whether and how often the respondent used the different wood burning appliances and how much wood they burned annually. It also asked demographic questions about the respondents. EPA used statistical regression approaches to develop appliance fractions and burn rates for each county, based on predictor variables from the survey responses. These predictor variables include:

- The number of heating degree days in 2017 associated with the climate zone where the respondent lives, from NOAA.<sup>3</sup>
- The population density in 2017 of the county the respondent lives in, from the Census Bureau.<sup>4</sup>
- Whether the zip code where the respondent lives is considered urban or rural, according to data from the Census Bureau.<sup>5</sup>
- The percentage of forest cover in the county where the respondent lives, according to the Biogenic Emissions Landuse Database (BELD, v4.1).<sup>6</sup>
- The fraction of homes that use natural gas as a primary heat source in 2017 in the county where the respondent lives, according to data from the American Community Survey.<sup>7</sup>
- The type of home the respondent lives in (single family detached, single family attached, multifamily, mobile), based on responses in the CEC survey.

The regression analysis compared all respondents who said they used a given appliance, such as a woodstove, to develop an equation based on each of these predictor variables. For example, survey respondents who lived in areas with more heating degree days (i.e. colder climates) or areas where few homes used natural gas as a primary heat sources (i.e. they might not have much natural gas service) tended to be more likely to say that they used a given wood-burning appliance.

The regression equation estimates the probability that a home in a given county, with a given set of predictor variables, will use each wood-burning appliance. Therefore when values of the predictor variables from each county are plugged into the equation, the result is a county-specific appliance fraction, which represents the fraction of homes in that county that use each wood-burning appliance. For example, urban counties with a low number of heating degree days, high population density, low forest cover, and many homes using natural gas tend to have a low appliance fraction for most appliances. County-specific appliance fractions are calculated separately for six appliance types: fireplaces, fireplace inserts, woodstoves, pellet stoves, central heaters (e.g. wood boilers or furnaces), and outdoor recreational equipment (such as fire pits). The process for splitting these appliance types into each of the 15 SCCs is discussed below.

Burn rates, which represent the average amount of wood burned in each appliance, are also calculated using regression analysis and the same predictor variables listed above. When county-level values of the predictor variables are plugged into the burn rate regression equation, the result is county-specific burn rates for each appliance type. The burn rates include the same appliance types as the appliance fractions.

The appliance fractions and burn rates are multiplied by the number of occupied homes in each county from the American Community Survey<sup>7</sup> to estimate the amount of wood burned in each county, in cords or tons, depending on whether the appliance burns cordwood or pellets. For devices that burn cordwood, the estimated number of cords burned in each county is multiplied by a county-level wood density factor from the U.S. Forest Service.<sup>2</sup>

$$W_{c,a} = H_c \times AF_{c,a} \times BR_{c,a} \times D_c \quad (1)$$

Where:

$W_{c,a}$	=	Amount of wood burned in appliance type $a$ in county $c$ , in tons per year
$H_c$	=	Number of occupied homes in county $c$
$AF_{c,a}$	=	Appliance fraction for appliance type $a$ in county $c$ , determined from the CEC survey
$BR_{c,a}$	=	Burn rate for appliance type $a$ in county $c$ , determined from the CEC survey, in cords or tons burned per appliance
$D_c$	=	Wood density factor for county $c$ , in tons per cord of wood (used only for cordwood appliance types)

As discussed above, the appliance fractions and burn rates are used to estimate wood-burning activity at the appliance level in each county. This activity for certain appliance types must be distributed from the appliance level to the specific SCC level. For example, wood burned in “woodstoves” must be apportioned to three SCCs: non-EPA certified stoves, EPA certified non-catalytic stoves, and EPA certified catalytic stoves. For woodstoves and fireplace inserts, EPA used distribution profiles based on a combination of data from the 2015 EIA Residential Energy Consumption Survey (RECS) and the state of Minnesota’s 2014/2015 residential wood survey.

Data from RECS is used to determine whether woodstoves or fireplace inserts are EPA certified. Although RECS does not specifically ask whether the woodstove is EPA certified, it does ask the age of the appliance. It is assumed that any appliance in the oldest age bin in RECS (20 years or older) is uncertified.\* All appliances less than 20 years old are assumed to be EPA certified. The split between EPA certified non-catalytic and catalytic stoves is based on data provided by Minnesota from their 2014/2015 residential wood survey, which suggests that certified stoves are 60 percent non-catalytic and 40 percent catalytic. The distribution profiles for woodstoves and fireplace inserts are shown in Table 1.

The CEC survey data were seen to be more reliable for developing distribution profiles for central heaters, including wood boilers and furnaces. Survey respondents listed whether they owned a furnace or a boiler, whether it was located inside or outside the home, and whether it burned cordwood or pellets. These responses were used to develop distribution profiles for the central heaters. The distribution profiles for central heaters are shown in Table 2.

The default distribution profiles are estimated at the Census Region level for woodstoves and fireplace inserts and nationally for central heaters, but the RWC tool allows the profiles to be adjusted for each county. Not all appliance types need to be distributed. Appliance populations of fireplaces, pellet stoves, and outdoor recreational equipment are estimated directly from the regression equations and are not multiplied distribution fractions.

The amount of wood-burning activity in each SCC in each county is determined by multiplying the county-level wood-burning activity by appliance type by the distribution profile for each SCC.

$$W_{c,SCC} = W_{c,a} \times DP_{SCC} \quad (2)$$

Where:

$W_{c,SCC}$	=	Amount of wood burned in each SCC in county $c$ , in tons per year
$W_{c,a}$	=	Amount of wood burned in appliance type $a$ in county $c$ , in cords or tons per year, from equation 1
$DP_{SCC}$	=	Distribution profile for each SCC from Table 1 or Table 2, depending on the appliance type

\* A 20-year-old appliance in the 2015 RECS would have been manufactured in 1995, which is after the 1988 NSPS for wood stoves. However, this is the oldest age bin in RECS. EPA lacks data on the fraction of appliances in this age bin that were manufacturer before or after 1988. Therefore EPA assumed that all appliances in this age bin were uncertified.

**Table 1. Distribution profiles for woodstoves and fireplace inserts by Census Region.**

Woodstove or Fireplace Insert Type	Census Region			
	NE	MW	S	W
Uncertified	0.16	0.12	0.31	0.31
Certified Catalytic	0.34	0.35	0.28	0.28
Certified Non-catalytic	0.50	0.53	0.41	0.41

**Table 2. Distribution profiles for central heaters.**

Type of Central Heater	SCC	Distribution Profile
Indoor pellet boiler	2104008630	0.01
Indoor pellet furnace	2104008530	0.03
Indoor cordwood boiler	2104008620	0.23
Indoor cordwood furnace	2104008510	0.37
Outdoor cordwood boiler	2104008610	0.36

After an initial review of the wood-burning activity predicted by the appliance fractions and burn rates develop from the CEC survey data, EPA decided to make two adjustments to the estimates. The first adjustment corrects the total wood-burning activity in each state. The amount of residential wood-burning activity initially predicted by the appliance fractions and burn rates was significantly higher than the state-level totals reported by EIA's State Energy Data System (SEDS)<sup>8</sup> for most states. As a result, EPA developed an adjustment factor to normalize the state-level residential wood-burning activity predicted by the tool to the amount predicted by SEDS. The SEDS adjustment factor is developed by summing the predicted amount of wood-burning activity (in cords) to the state level in each state and dividing it by the state-level amount of residential wood consumption reported by SEDS. SEDS reports wood consumption in Btu, rather than cords; therefore the wood-burning activity predicted by the RWC tool is converted from cords to Btu using a conversion factor of 20 million Btu per cord, from the SEDS documentation. In addition, SEDS only includes wood consumption for residential heating; therefore predicted wood consumption from outdoor recreational wood-burning (2104008700) and wax firelogs (2104009000) are not summed to calculate the SEDS adjustment.

$$SAF_s = \frac{\sum W_{c,SCC}}{W_{s,SEDS}} \quad (3)$$

Where:

- $SAF_s$  = SEDS adjustment factor for state  $s$
- $W_{c,SCC}$  = Amount of wood burned in each SCC in county  $c$ , in tons per year
- $W_{s,SEDS}$  = Amount of wood consumption in state  $s$  reported by SEDS

The second adjustment EPA made to the predicted wood consumption relates to central heaters and outdoor recreational equipment. After an initial review of predicted wood-burning activity, EPA felt that the estimated amount of wood burned in these appliances in dense urban areas was unreasonably high. Therefore, EPA developed a second adjustment factor based on the housing density (homes/mi<sup>2</sup>) in each county, based on the equation for a sigmoid curve. The housing density adjustment factor is calibrated such that it approaches 0 when county-level housing density approaches 1,000 homes/mi<sup>2</sup>. The housing density adjustment factor is multiplied by the predicted wood-burning activity only for central heating appliances (wood boilers and furnaces) and outdoor recreational wood-burning appliances.

$$HAF_c = -\frac{1}{1 + e^{-0.01(HD_c - 500)}} + 1 \quad (4)$$

Where:

$HAF_s$  = Housing density adjustment factor for county  $c$   
 $HD_c$  = Housing density in county  $c$ , in homes/mi<sup>2</sup>

The SEDS and housing density adjustment factors are multiplied by the county-level predicted wood-burning activity to develop the adjusted wood-burning activity in each county.

$$AW_{c,SCC} = W_{c,SCC} \times SAF_s \times HAF_c \quad (5)$$

Where:

$AW_{c,SCC}$  = Adjusted amount of wood burned in each SCC in county  $c$ , in tons per year  
 $SAF_s$  = SEDS adjustment factor for state  $s$   
 $HAF_s$  = Housing density adjustment factor for county  $c$

Note that the appliance fractions and burn rates provided in the input templates already take into account the housing density and SEDS adjustments. Therefore the input templates for RWC do not ask SLT agencies to submit values for the housing density or SEDS adjustments. Rather, SLT agencies need only to submit revisions to the appliance fractions and burn rates themselves. Equations 4 and 5 are included here only to provide more information about how the appliance fractions and burn rates were adjusted.

#### D. Allocation Procedure

Appliance fractions and burn rates are calculated at the county-level. There is no need to allocate data to the county level for this category.

#### E. Emissions Factors

Emissions factors for RWC come primarily from AP-42<sup>9</sup> and Houck and Eagle (2006),<sup>10</sup> but also from Houck et al. (2001). Many of the HAP emissions factors are from Hays et al. (2003).<sup>11</sup> Emissions factors for wax firelogs are from Li and Rosenthal (2006).<sup>12</sup> Additional emission factors are taken from Houck et al. (2001)<sup>13</sup> and Aurell et al. (2012).<sup>14</sup> Table 3, in the appendix, lists the emissions factors for each SCC.

For certified woodstoves and fireplace inserts, EPA is using the emissions factors from the Regulatory Impact Analysis (RIA) for the 2015 New Source Performance Standards (NSPS),<sup>15</sup> which is based on the woodstove emissions standards from the state of Washington in 1995. The RIA notes that the emissions factors for woodstove, fireplace inserts, and pellet stoves will not decrease from that level until the Step 2 standards become effective in 2020. Therefore, EPA used the Washington state emissions factors to estimate 2017 emissions for these categories.

While the NSPS was expected to decrease emissions for hydronic heaters and furnaces in 2015, EPA lacks data on the fraction of these appliances in use that were manufactured after the 2015 NSPS went into effect. Therefore, EPA made no changes to the emissions factors for hydronic heaters or furnaces.

#### F. Controls

There are no controls assumed for this category. However, SLT agencies may submit state- or county-level control factors that will adjust the emissions by SCC.

#### G. Emissions

Emissions from RWC are calculated by multiplying the adjusted amount of wood burned in each SCC in each county by SCC- and pollutant-specific emissions factors from Table 3.

$$E_{c,SCC,p} = AW_{c,SCC} \times EF_{SCC,p} \quad (6)$$

Where:

$$\begin{aligned} E_{c,SCC,p} &= \text{Emissions of pollutant } p \text{ from each SCC in county } c \\ AW_{c,SCC} &= \text{Adjusted amount of wood burned in each SCC in county } c, \text{ in tons per year} \\ EF_{SCC,p} &= \text{Emissions factor for pollutant } p \text{ for each SCC, from Table 3} \end{aligned}$$

## H. Point Source Subtraction

There are no point source-specific SCCs for RWC; therefore point source subtraction is not performed for this category.

## I. Sample Calculations

Table 3 lists sample calculations for the estimation of emissions of PM25-PRI from non-EPA certified wood stoves in Delaware County, OH.

Note that the appliance fractions and burn rates provided in the input templates already take into account the housing density and SEDS adjustments. Therefore the input templates for RWC do not ask SLT agencies to submit values for the housing density or SEDS adjustments. Rather, SLT agencies need only to submit revisions to the appliance fractions and burn rates themselves. Equations 4 and 5 are included here only to provide more information about how the appliance fractions and burn rates were adjusted.

**Table 3. Sample calculations for PM25-PRI emissions from non EPA certified woodstoves in Delaware County, OH.**

Eq. #	Equation	Values for Delaware County, OH	Result
1	$W_{c,a} = H_c \times AF_{c,a} \times BR_{c,a} \times D_c$	$67,701 \text{ homes} \times 0.0751 \times 1.9304 \times 1.3341 \text{ tons/cord}$	13,094 tons of wood burned in woodstoves
2	$W_{c,SCC} = W_{c,a} \times DP_{SCC}$	$13,094 \times 0.12$	1,571 tons of wood burned in non-EPA certified woodstoves
3	$SAF_s = \frac{W_{s,SEDS}}{\sum W_{c,SCC}}$	$\frac{14,714 \text{ BBtu}}{28,369 \text{ BBtu}}$	0.52 SEDS adjustment factor
4	$HAF_c = -\frac{1}{1 + e^{-0.01 (HD_c - 500)}} + 1$	$-\frac{1}{1 + e^{-0.01 (153 - 500)}} + 1$	0.97 housing adjustment factor
5	$AW_{c,SCC} = W_{c,SCC} \times SAF_s \times HAF_c$	$1,571 \times 0.52 \times 0.97$	792 adjusted tons of wood burned in non-EPA certified woodstoves
6	$E_{c,SCC,p} = AW_{c,SCC} \times EF_{SCC,p}$	$792 \times 30.6 \text{ lb/ton}$	24,235 lbs. (12.12 tons) PM25-PRI from non-EPA certified woodstoves in Delaware County, OH

## J. Changes from 2014 Methodology

The largest changes from the 2014 methodology are the source of the data used to develop the appliance fractions and burn rates. In 2014, the appliance fractions and burn rates were calculated based on survey data from the 2009 EIA RECS, while in 2017 the appliance fractions and burn rates are calculated based on the CEC survey data. In addition, while EPA lacked data in 2014 to estimate county-level appliance fractions and burn rates for outdoor

recreational wood-burning equipment and wax firelogs, EPA was able to estimate appliance fractions and burn rates for these categories for 2017 using data from the CEC survey. The general approach for using regression analysis to develop county level appliance fractions and burn rates is unchanged from 2014.

Another change involves the estimation of emissions for three additional SCCs: indoor pellet boilers, indoor pellet furnaces, and indoor hydronic heaters.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, so emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in tons for these two Florida counties are divided by their respective populations creating a tons per capita emission factor. For each Puerto Rico and US Virgin Island County, the tons per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which served as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## L. References

- <sup>1</sup> CEC. 2019. Residential Wood Use Survey to Improve Black Carbon Emissions Inventory Data for Small-Scale Biomass Combustion. Montreal, Canada: Commission for Environmental Cooperation.
- <sup>2</sup> U.S. Department of Agriculture (USDA). 2009. "Timber Products Output Survey," U.S. Forest Service, retrieved via query from [https://www.fs.usda.gov/srsfia/php/tpo\\_2009/tpo\\_rpa\\_intl.php](https://www.fs.usda.gov/srsfia/php/tpo_2009/tpo_rpa_intl.php)
- <sup>3</sup> NOAA. 2019. Degree Days Statistics. Washington, DC: National Weather Service, Climate Prediction Center. [https://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/cdus/degree\\_days/](https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/)
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- <sup>5</sup> U.S. Census Bureau. 2018. Urban and Rural. Washington, DC. <https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html>
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- <sup>7</sup> U.S. Census Bureau. 2018. American Community Survey. Washington, DC. <https://www.census.gov/programs-surveys/acs>
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- <sup>9</sup> U.S. Environmental Protection Agency. 1996. AP-42, Fifth Edition, Chapter 1 External Combustion Sources, Sections 1.9 Residential Fireplaces and 1.10 Residential Wood Stove.
- <sup>10</sup> Houck, J.E. and B.N. Eagle. 2006. Task 6 Technical Memorandum 4 (Final Report): Control Analysis and Documentation for Residential Wood Combustion in the MANE-VU Region. Prepared for MARAMA.
- <sup>11</sup> Hays, M.D., et al. 2003. Polycyclic aromatic hydrocarbon size distributions in aerosols from appliances of residential wood combustion as determined by direct thermal desorption—GC/MS. *Journal of Aerosol Science*, 34:1061-1084.
- <sup>12</sup> Li, V.S. and S.R. Rosenthal. 2006. Content and Emission Characteristics of Artificial Wax Firelogs. Poster presentation at 15th International Emission Inventory Conference. New Orleans, Louisiana. May 15-18, 2006.
- <sup>13</sup> Houck, J.E., J. Crouch, and R.H. Huntley. 2001. Review of Wood Heater and Fireplace Emission Factors. Technical presentation at the International Emission Inventory Conference. Denver, CO.
- <sup>14</sup> Aurell, J., B.K. Gullett, D. Tabor, et al. 2012. Semivolatile and Volatile Organic Compound Emissions from Wood-Fired Hydronic Heaters. *Environmental Science and Technology*, 46: 7898-7904.
- <sup>15</sup> U.S. Environmental Protection Agency. 2015. Regulatory Impact Analysis (RIA) for Residential Wood Heaters NPSR Revision. Final Report. Research Triangle Park, NC. <https://www.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf>

**Table 4. Emissions factors for residential wood combustion.**

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008100	Fireplace: general	Ammonia	1.8	10
2104008100	Fireplace: general	Carbon Monoxide	149	10
2104008100	Fireplace: general	Nitrogen Oxides	2.6	9
2104008100	Fireplace: general	Primary PM10	23.6	13
2104008100	Fireplace: general	Primary PM2.5	23.6	13
2104008100	Fireplace: general	Sulfur Dioxide	0.4	9
2104008100	Fireplace: general	Volatile Organic Compounds	18.9	10
2104008100	Fireplace: general	1,3-Butadiene	0.157	10
2104008100	Fireplace: general	Acetaldehyde	1.07	10
2104008100	Fireplace: general	Acrolein	0.123	10
2104008100	Fireplace: general	Benzene	0.686	10
2104008100	Fireplace: general	Benzo[a]Pyrene	0.001	10
2104008100	Fireplace: general	Cresols (Includes o, m, & p)/Cresylic Acids	0.357	10
2104008100	Fireplace: general	Formaldehyde	1.79	10
2104008100	Fireplace: general	Mercury	4.26E-05	9
2104008100	Fireplace: general	Naphthalene	0.265	10
2104008100	Fireplace: general	Phenol	0.472	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Ammonia	1.7	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Carbon Monoxide	230.8	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Nitrogen Oxides	2.8	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Primary PM10	30.6	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Primary PM2.5	30.6	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Sulfur Dioxide	0.4	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Volatile Organic Compounds	53	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	1,3-Butadiene	0.39	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Acenaphthene	0.00621	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Acenaphthylene	0.132	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Acetaldehyde	0.616	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008210	Woodstove: fireplace inserts; non-EPA certified	Acrolein	0.091	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Anthracene	0.00869	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzene	1.938	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[a]anthracene	0.000577	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[a]fluoranthene	0.000321	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[a]Pyrene	0.000979	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[b]fluoranthene	0.000592	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[c]Pyrene	0.000589	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[g,h,i,]Perylene	0.000201	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Benzo[k]Fluoranthene	0.000509	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Cadmium	0.000022	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Chrysene	0.000472	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Cresols (Includes o, m, & p)/Cresylic Acids	0.16	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Dibenzo[ah]anthracene	3.92E-05	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Fluoranthene	0.000249	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Fluorene	0.0149	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Formaldehyde	1.45	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Indeno[1; 2; 3 - cd]pyrene	0.000408	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Manganese	0.00017	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Mercury	4.26E-05	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Methylchrysene	5.84E-05	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Naphthalene	0.179	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Nickel	0.000014	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	o-Xylene	0.202	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Perylene	0.000155	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Phenanthrene	0.0484	9
2104008210	Woodstove: fireplace inserts; non-EPA certified	Phenol	0.295	10
2104008210	Woodstove: fireplace inserts; non-EPA certified	Pyrene	0.000217	11
2104008210	Woodstove: fireplace inserts; non-EPA certified	Toluene	0.73	9

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Ammonia	0.665816	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Carbon Monoxide	122.6	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Nitrogen Oxides	1.686735	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Primary PM10	8.76	15
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Primary PM2.5	8.76	15
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Sulfur Dioxide	0.295918	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Volatile Organic Compounds	8.877551	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	1,3-Butadiene	0.129464	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Acenaphthene	0.002989	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Acenaphthylene	0.009543	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Acetaldehyde	0.467551	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Acrolein	0.029888	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Anthracene	0.002693	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzene	0.709464	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[a]anthracene	0.000427	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[a]fluoranthene	0.000237	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[a]Pyrene	0.000725	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[b]Fluoranthene	0.000438	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[e]Pyrene	0.000436	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[g,h,i,]Perylene	0.000149	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Benzo[k]Fluoranthene	0.000377	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Cadmium	1.48E-05	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Chrysene	0.000349	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Cresols (Includes o, m, & p)/Cresylic Acids	0.341786	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Dibenzo[ah]anthracene	2.9E-05	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Fluoranthene	0.000184	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Fluorene	0.004187	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Formaldehyde	1.642347	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Indeno[1; 2; 3 . cd]pyrene	0.000302	11

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Manganese	0.000104	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Mercury	4.26E-05	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Methylchrysene	4.32E-05	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Naphthalene	0.043056	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Nickel	1.48E-05	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Perylene	0.000115	11
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Phenanthrene	0.035288	9
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Phenol	0.360281	10
2104008220	Woodstove: fireplace inserts; EPA certified; non-catalytic	Pyrene	0.000161	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Ammonia	0.670588	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Carbon Monoxide	92.3	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Nitrogen Oxides	1.490196	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Primary PM10	9.72	15
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Primary PM2.5	9.72	15
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Sulfur Dioxide	0.298039	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Volatile Organic Compounds	11.17647	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	1,3-Butadiene	0.145294	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Acenaphthene	0.002295	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Acenaphthylene	0.026004	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Acetaldehyde	0.395647	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Acrolein	0.023396	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Anthracene	0.003055	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzene	1.090824	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[a]anthracene	0.00043	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[a]fluoranthene	0.000239	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[a]Pyrene	0.00073	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[b]Fluoranthene	0.000441	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[e]Pyrene	0.000439	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[g,h,i.]Perylene	0.00015	11

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Benzo[k]Fluoranthene	0.000379	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Chrysene	0.000351	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Cresols (Includes o, m, & p)/Cresylic Acids	0.395647	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Dibenzo[ah]anthracene	2.92E-05	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Fluoranthene	0.000185	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Fluorene	0.00535	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Formaldehyde	0.731686	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Indeno[1; 2; 3 - cd]pyrene	0.000304	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Mercury	4.26E-05	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Methylchrysene	4.35E-05	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Naphthalene	0.071082	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	o-Xylene	0.138588	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Perylene	0.000116	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Phenanthrene	0.018329	9
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Phenol	0.304	10
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Pyrene	0.000162	11
2104008230	Woodstove: fireplace inserts; EPA certified; catalytic	Toluene	0.387451	9
2104008310	Woodstove: freestanding, non-EPA certified	Ammonia	1.7	10
2104008310	Woodstove: freestanding, non-EPA certified	Carbon Monoxide	230.8	9
2104008310	Woodstove: freestanding, non-EPA certified	Nitrogen Oxides	2.8	9
2104008310	Woodstove: freestanding, non-EPA certified	Primary PM10	30.6	9
2104008310	Woodstove: freestanding, non-EPA certified	Primary PM2.5	30.6	9
2104008310	Woodstove: freestanding, non-EPA certified	Sulfur Dioxide	0.4	9
2104008310	Woodstove: freestanding, non-EPA certified	Volatile Organic Compounds	53	9
2104008310	Woodstove: freestanding, non-EPA certified	1,3-Butadiene	0.39	10
2104008310	Woodstove: freestanding, non-EPA certified	Acenaphthene	0.00621	9
2104008310	Woodstove: freestanding, non-EPA certified	Acenaphthylene	0.132	9
2104008310	Woodstove: freestanding, non-EPA certified	Acetaldehyde	0.616	10
2104008310	Woodstove: freestanding, non-EPA certified	Acrolein	0.091	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008310	Woodstove: freestanding, non-EPA certified	Anthracene	0.00869	9
2104008310	Woodstove: freestanding, non-EPA certified	Benzene	1.938	9
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[a]anthracene	0.000577	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[a]fluoranthene	0.000321	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[a]Pyrene	0.000979	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[b]fluoranthene	0.000592	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[e]Pyrene	0.000589	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[g,h,i,]Perylene	0.000201	11
2104008310	Woodstove: freestanding, non-EPA certified	Benzo[k]Fluoranthene	0.000509	11
2104008310	Woodstove: freestanding, non-EPA certified	Cadmium	0.000022	9
2104008310	Woodstove: freestanding, non-EPA certified	Chrysene	0.000472	11
2104008310	Woodstove: freestanding, non-EPA certified	Cresols (Includes o, m, & p)/Cresylic Acids	0.16	10
2104008310	Woodstove: freestanding, non-EPA certified	Dibenzo[ah]anthracene	3.92E-05	11
2104008310	Woodstove: freestanding, non-EPA certified	Fluoranthene	0.000249	11
2104008310	Woodstove: freestanding, non-EPA certified	Fluorene	0.0149	9
2104008310	Woodstove: freestanding, non-EPA certified	Formaldehyde	1.45	10
2104008310	Woodstove: freestanding, non-EPA certified	Indeno[1; 2; 3 . cd]pyrene	0.000408	11
2104008310	Woodstove: freestanding, non-EPA certified	Manganese	0.00017	9
2104008310	Woodstove: freestanding, non-EPA certified	Mercury	4.26E-05	9
2104008310	Woodstove: freestanding, non-EPA certified	Methylchrysene	5.84E-05	11
2104008310	Woodstove: freestanding, non-EPA certified	Naphthalene	0.179	9
2104008310	Woodstove: freestanding, non-EPA certified	Nickel	0.000014	9
2104008310	Woodstove: freestanding, non-EPA certified	o-Xylene	0.202	9
2104008310	Woodstove: freestanding, non-EPA certified	Perylene	0.000155	11
2104008310	Woodstove: freestanding, non-EPA certified	Phenanthrene	0.0484	9
2104008310	Woodstove: freestanding, non-EPA certified	Phenol	0.295	10
2104008310	Woodstove: freestanding, non-EPA certified	Pyrene	0.000217	11
2104008310	Woodstove: freestanding, non-EPA certified	Toluene	0.73	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Ammonia	0.665816	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Carbon Monoxide	122.6	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Nitrogen Oxides	1.686735	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Primary PM10	8.76	15
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Primary PM2.5	8.76	15
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Sulfur Dioxide	0.295918	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Volatile Organic Compounds	8.877551	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	1,3-Butadiene	0.129464	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Acenaphthene	0.002989	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Acenaphthylene	0.009543	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Acetaldehyde	0.467551	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Acrolein	0.029888	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Anthracene	0.002693	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzene	0.709464	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[a]anthracene	0.000427	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[a]fluoranthene	0.000237	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[a]Pyrene	0.000725	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[b]Fluoranthene	0.000438	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[e]Pyrene	0.000436	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[g,h,i.]Perylene	0.000149	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Benzo[k]Fluoranthene	0.000377	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Cadmium	1.48E-05	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Chrysene	0.000349	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Cresols (Includes o, m, & p)/Cresylic Acids	0.341786	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Dibenzo[ah]anthracene	2.9E-05	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Fluoranthene	0.000184	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Fluorene	0.004187	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Formaldehyde	1.642347	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Indeno[1; 2; 3 . cd]pyrene	0.000302	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Manganese	0.000104	9

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Mercury	4.26E-05	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Methylchrysene	4.32E-05	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Naphthalene	0.043056	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Nickel	1.48E-05	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Perylene	0.000115	11
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Phenanthrene	0.035288	9
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Phenol	0.360281	10
2104008320	Woodstove: freestanding, EPA certified, non-catalytic	Pyrene	0.000161	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Ammonia	0.670588	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Carbon Monoxide	92.3	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Nitrogen Oxides	1.490196	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Primary PM10	9.72	15
2104008330	Woodstove: freestanding, EPA certified, catalytic	Primary PM2.5	9.72	15
2104008330	Woodstove: freestanding, EPA certified, catalytic	Sulfur Dioxide	0.298039	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Volatile Organic Compounds	11.17647	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	1,3-Butadiene	0.145294	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Acenaphthene	0.002295	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Acenaphthylene	0.026004	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Acetaldehyde	0.395647	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Acrolein	0.023396	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Anthracene	0.003055	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzene	1.090824	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[a]anthracene	0.00043	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[a]fluoranthene	0.000239	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[a]Pyrene	0.00073	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[b]Fluoranthene	0.000441	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[e]Pyrene	0.000439	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[g,h,i]Perylene	0.00015	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Benzo[k]Fluoranthene	0.000379	11

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008330	Woodstove: freestanding, EPA certified, catalytic	Chrysene	0.000351	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Cresols (Includes o, m, & p)/Cresylic Acids	0.395647	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Dibenzo[ah]anthracene	2.92E-05	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Fluoranthene	0.000185	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Fluorene	0.00535	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Formaldehyde	0.731686	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Indeno[1; 2; 3 - cd]pyrene	0.000304	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Mercury	4.26E-05	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Methylchrysene	4.35E-05	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Naphthalene	0.071082	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	o-Xylene	0.138588	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Perylene	0.000116	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Phenanthrene	0.018329	9
2104008330	Woodstove: freestanding, EPA certified, catalytic	Phenol	0.304	10
2104008330	Woodstove: freestanding, EPA certified, catalytic	Pyrene	0.000162	11
2104008330	Woodstove: freestanding, EPA certified, catalytic	Toluene	0.387451	9
2104008400	Woodstove: pellet-fired, general	Ammonia	0.3	10
2104008400	Woodstove: pellet-fired, general	Carbon Monoxide	15.9	10
2104008400	Woodstove: pellet-fired, general	Nitrogen Oxides	3.8	10
2104008400	Woodstove: pellet-fired, general	Primary PM10	3.06	10
2104008400	Woodstove: pellet-fired, general	Primary PM2.5	3.06	10
2104008400	Woodstove: pellet-fired, general	Sulfur Dioxide	0.32	10
2104008400	Woodstove: pellet-fired, general	Volatile Organic Compounds	2.198	10
2104008400	Woodstove: pellet-fired, general	1,3-Butadiene	0.00095	10
2104008400	Woodstove: pellet-fired, general	Acetaldehyde	0.094	10
2104008400	Woodstove: pellet-fired, general	Acrolein	0.0101	10
2104008400	Woodstove: pellet-fired, general	Benzene	0.0289	10
2104008400	Woodstove: pellet-fired, general	Benzo[a]Pyrene	0.0067	10
2104008400	Woodstove: pellet-fired, general	Chrysene	7.52E-05	9

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008400	Woodstove: pellet-fired, general	Cresols (Includes o, m, & p)/Cresylic Acids	0.0155	10
2104008400	Woodstove: pellet-fired, general	Fluoranthene	5.48E-05	9
2104008400	Woodstove: pellet-fired, general	Formaldehyde	0.316	10
2104008400	Woodstove: pellet-fired, general	Mercury	4.26E-05	9
2104008400	Woodstove: pellet-fired, general	Naphthalene	0.423	10
2104008400	Woodstove: pellet-fired, general	Phenanthrene	3.32E-05	9
2104008400	Woodstove: pellet-fired, general	Phenol	0.025	10
2104008400	Woodstove: pellet-fired, general	Pyrene	4.84E-05	9
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Ammonia	1.8	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Carbon Monoxide	184	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Nitrogen Oxides	1.8	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Primary PM10	27.6	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Primary PM2.5	27.6	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Sulfur Dioxide	2.03	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Volatile Organic Compounds	11.7	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	1,3-Butadiene	0.029032	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Acetaldehyde	0.682	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Acrolein	0.043792	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Benzene	2.78	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Benzo[a]Pyrene	0.002733	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Cresols (Includes o, m, & p)/Cresylic Acids	0.131139	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Formaldehyde	0.7	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Mercury	4.26E-05	9
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Naphthalene	0.148635	10
2104008510	Furnace: Indoor, cordwood-fired, non-EPA certified	Phenol	0.241	10
2104008610	Hydronic heater: outdoor	Ammonia	1.7	10
2104008610	Hydronic heater: outdoor	Carbon Monoxide	360	14
2104008610	Hydronic heater: outdoor	Nitrogen Oxides	2	9
2104008610	Hydronic heater: outdoor	Primary PM10	64	14

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008610	Hydronic heater: outdoor	Primary PM2.5	64	14
2104008610	Hydronic heater: outdoor	Sulfur Dioxide	2.03	10
2104008610	Hydronic heater: outdoor	Volatile Organic Compounds	67.4	14
2104008610	Hydronic heater: outdoor	1,3-Butadiene	0.029032	10
2104008610	Hydronic heater: outdoor	Acetaldehyde	0.682	10
2104008610	Hydronic heater: outdoor	Acrolein	0.043792	10
2104008610	Hydronic heater: outdoor	Benzene	2.78	10
2104008610	Hydronic heater: outdoor	Benzo[a]Pyrene	0.002733	10
2104008610	Hydronic heater: outdoor	Cresols (Includes o, m, & p)/Cresylic Acids	0.131139	10
2104008610	Hydronic heater: outdoor	Formaldehyde	0.7	10
2104008610	Hydronic heater: outdoor	Mercury	4.26E-05	9
2104008610	Hydronic heater: outdoor	Naphthalene	0.148635	10
2104008610	Hydronic heater: outdoor	Phenol	0.241	10
2104008700	Outdoor wood burning device, NEC	Ammonia	1.8	10
2104008700	Outdoor wood burning device, NEC	Carbon Monoxide	149	10
2104008700	Outdoor wood burning device, NEC	Nitrogen Oxides	2.6	9
2104008700	Outdoor wood burning device, NEC	Primary PM10	23.6	9
2104008700	Outdoor wood burning device, NEC	Primary PM2.5	23.6	13
2104008700	Outdoor wood burning device, NEC	Sulfur Dioxide	0.4	9
2104008700	Outdoor wood burning device, NEC	Volatile Organic Compounds	18.9	10
2104008700	Outdoor wood burning device, NEC	1,3-Butadiene	0.157	10
2104008700	Outdoor wood burning device, NEC	Acetaldehyde	1.07	10
2104008700	Outdoor wood burning device, NEC	Acrolein	0.123	10
2104008700	Outdoor wood burning device, NEC	Benzene	0.686	10
2104008700	Outdoor wood burning device, NEC	Benzo[a]Pyrene	0.001	10
2104008700	Outdoor wood burning device, NEC	Cresols (Includes o, m, & p)/Cresylic Acids	0.357	10
2104008700	Outdoor wood burning device, NEC	Formaldehyde	1.79	10
2104008700	Outdoor wood burning device, NEC	Mercury	4.26E-05	9
2104008700	Outdoor wood burning device, NEC	Naphthalene	0.265	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008700	Outdoor wood burning device, NEC	Phenol	0.472	10
2104009000	Residential Firelog Total: All Combustor Types	Carbon Monoxide	125.08	12
2104009000	Residential Firelog Total: All Combustor Types	Nitrogen Oxides	7.684	12
2104009000	Residential Firelog Total: All Combustor Types	Primary PM10	29.32	12
2104009000	Residential Firelog Total: All Combustor Types	Primary PM2.5	28.4	12
2104009000	Residential Firelog Total: All Combustor Types	Volatile Organic Compounds	39.56	12
2104009000	Residential Firelog Total: All Combustor Types	Acenaphthene	0.00168	12
2104009000	Residential Firelog Total: All Combustor Types	Acenaphthylene	0.00748	12
2104009000	Residential Firelog Total: All Combustor Types	Anthracene	0.00232	12
2104009000	Residential Firelog Total: All Combustor Types	Benzene	1.068	12
2104009000	Residential Firelog Total: All Combustor Types	Benzo[a]anthracene	0.0012	12
2104009000	Residential Firelog Total: All Combustor Types	Benzo[a]Pyrene	0.0012	12
2104009000	Residential Firelog Total: All Combustor Types	Benzo[b]Fluoranthene	0.00112	12
2104009000	Residential Firelog Total: All Combustor Types	Benzo[g,h,i,]Perylene	0.00068	12
2104009000	Residential Firelog Total: All Combustor Types	Benzo[k]Fluoranthene	0.0006	12
2104009000	Residential Firelog Total: All Combustor Types	Chrysene	0.00188	12
2104009000	Residential Firelog Total: All Combustor Types	Dibenzo[a,h]Anthracene	0.0006	12
2104009000	Residential Firelog Total: All Combustor Types	Fluoranthene	0.00428	12
2104009000	Residential Firelog Total: All Combustor Types	Fluorene	0.00548	12
2104009000	Residential Firelog Total: All Combustor Types	Indeno[1,2,3-c,d]Pyrene	0.00068	12
2104009000	Residential Firelog Total: All Combustor Types	Naphthalene	0.09756	12
2104009000	Residential Firelog Total: All Combustor Types	Phenanthrene	0.01724	12
2104009000	Residential Firelog Total: All Combustor Types	Pyrene	0.00424	12
2104008620	Hydronic heater: indoor	Ammonia	1.7	10
2104008620	Hydronic heater: indoor	Carbon Monoxide	360	14
2104008620	Hydronic heater: indoor	Nitrogen Oxides	2	9
2104008620	Hydronic heater: indoor	Primary PM10	64	14
2104008620	Hydronic heater: indoor	Primary PM2.5	64	14
2104008620	Hydronic heater: indoor	Sulfur Dioxide	2.03	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008620	Hydronic heater: indoor	Volatile Organic Compounds	67.4	14
2104008620	Hydronic heater: indoor	1,3-Butadiene	0.029032	10
2104008620	Hydronic heater: indoor	Acetaldehyde	0.682	10
2104008620	Hydronic heater: indoor	Acrolein	0.043792	10
2104008620	Hydronic heater: indoor	Benzene	2.78	10
2104008620	Hydronic heater: indoor	Benzo[a]Pyrene	0.002733	10
2104008620	Hydronic heater: indoor	Cresols (Includes o, m, & p)/Cresylic Acids	0.131139	10
2104008620	Hydronic heater: indoor	Formaldehyde	0.7	10
2104008620	Hydronic heater: indoor	Mercury	4.26E-05	9
2104008620	Hydronic heater: indoor	Naphthalene	0.148635	10
2104008620	Hydronic heater: indoor	Phenol	0.241	10
2104008630	Hydronic heater: pellet fired	Ammonia	0.3	10
2104008630	Hydronic heater: pellet fired	Carbon Monoxide	15.9	10
2104008630	Hydronic heater: pellet fired	Nitrogen Oxides	3.8	10
2104008630	Hydronic heater: pellet fired	Primary PM10	3.06	10
2104008630	Hydronic heater: pellet fired	Primary PM2.5	3.06	10
2104008630	Hydronic heater: pellet fired	Sulfur Dioxide	0.32	10
2104008630	Hydronic heater: pellet fired	Volatile Organic Compounds	2.198	10
2104008630	Hydronic heater: pellet fired	1,3-Butadiene	0.00095	10
2104008630	Hydronic heater: pellet fired	Acetaldehyde	0.094	10
2104008630	Hydronic heater: pellet fired	Acrolein	0.0101	10
2104008630	Hydronic heater: pellet fired	Benzene	0.0289	10
2104008630	Hydronic heater: pellet fired	Benzo[a]Pyrene	0.0067	10
2104008630	Hydronic heater: pellet fired	Chrysene	7.52E-05	9
2104008630	Hydronic heater: pellet fired	Cresols (Includes o, m, & p)/Cresylic Acids	0.0155	10
2104008630	Hydronic heater: pellet fired	Fluoranthene	5.48E-05	9
2104008630	Hydronic heater: pellet fired	Formaldehyde	0.316	10
2104008630	Hydronic heater: pellet fired	Mercury	4.26E-05	9
2104008630	Hydronic heater: pellet fired	Naphthalene	0.423	10

SCC	SCC Description	Pollutant	Emissions Factor (lb/ton)	Source
2104008630	Hydronic heater: pellet fired	Phenanthrene	3.32E-05	9
2104008630	Hydronic heater: pellet fired	Phenol	0.025	10
2104008630	Hydronic heater: pellet fired	Pyrene	4.84E-05	9
2104008530	Furnace: Indoor, pellet-fired, general	Ammonia	0.3	10
2104008530	Furnace: Indoor, pellet-fired, general	Carbon Monoxide	15.9	10
2104008530	Furnace: Indoor, pellet-fired, general	Nitrogen Oxides	3.8	10
2104008530	Furnace: Indoor, pellet-fired, general	Primary PM10	3.06	10
2104008530	Furnace: Indoor, pellet-fired, general	Primary PM2.5	3.06	10
2104008530	Furnace: Indoor, pellet-fired, general	Sulfur Dioxide	0.32	10
2104008530	Furnace: Indoor, pellet-fired, general	Volatile Organic Compounds	2.198	10
2104008530	Furnace: Indoor, pellet-fired, general	1,3-Butadiene	0.00095	10
2104008530	Furnace: Indoor, pellet-fired, general	Acetaldehyde	0.094	10
2104008530	Furnace: Indoor, pellet-fired, general	Acrolein	0.0101	10
2104008530	Furnace: Indoor, pellet-fired, general	Benzene	0.0289	10
2104008530	Furnace: Indoor, pellet-fired, general	Benzo[a]Pyrene	0.0067	10
2104008530	Furnace: Indoor, pellet-fired, general	Chrysene	7.52E-05	9
2104008530	Furnace: Indoor, pellet-fired, general	Cresols (Includes o, m, & p)/Cresylic Acids	0.0155	10
2104008530	Furnace: Indoor, pellet-fired, general	Fluoranthene	5.48E-05	9
2104008530	Furnace: Indoor, pellet-fired, general	Formaldehyde	0.316	10
2104008530	Furnace: Indoor, pellet-fired, general	Mercury	4.26E-05	9
2104008530	Furnace: Indoor, pellet-fired, general	Naphthalene	0.423	10
2104008530	Furnace: Indoor, pellet-fired, general	Phenanthrene	3.32E-05	9
2104008530	Furnace: Indoor, pellet-fired, general	Phenol	0.025	10
2104008530	Furnace: Indoor, pellet-fired, general	Pyrene	4.84E-05	9

## SOLVENT UTILIZATION

### A. Source Category Description

Solvent utilization includes a variety of industrial, commercial and residential applications of solvents that are not captured in the point source inventory. Estimates of emissions of volatile organic compounds (VOC) and hazardous air pollutants (HAPs) from solvent utilization are based on national-level estimates of solvent usage from the Freedonia Group. In 2014, Solvent utilization in the US, Puerto Rico, and US Virgin Islands resulted in over 3 million tons of VOC emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401001000	Solvent Utilization	Surface Coating	Architectural Coatings	Total: All Solvent Types
2401005000	Solvent Utilization	Surface Coating	Auto Refinishing	Total: All Solvent Types
2401008000	Solvent Utilization	Surface Coating	Traffic Markings	Total: All Solvent Types
2401015000	Solvent Utilization	Surface Coating	Factory Finished Wood	Total: All Solvent Types
2401020000	Solvent Utilization	Surface Coating	Wood Furniture	Total: All Solvent Types
2401025000	Solvent Utilization	Surface Coating	Metal Furniture	Total: All Solvent Types
2401030000	Solvent Utilization	Surface Coating	Paper	Total: All Solvent Types
2401040000	Solvent Utilization	Surface Coating	Metal Cans	Total: All Solvent Types
2401055000	Solvent Utilization	Surface Coating	Machinery and Equipment	Total: All Solvent Types
2401060000	Solvent Utilization	Surface Coating	Large Appliances	Total: All Solvent Types
2401065000	Solvent Utilization	Surface Coating	Electronics and Other Electrical	Total: All Solvent Types
2401070000	Solvent Utilization	Surface Coating	Motor Vehicles	Total: All Solvent Types
2401075000	Solvent Utilization	Surface Coating	Aircraft	Total: All Solvent Types
2401085000	Solvent Utilization	Surface Coating	Railroad	Total: All Solvent Types
2401080000	Solvent Utilization	Surface Coating	Marine	Total: All Solvent Types
2401090000	Solvent Utilization	Surface Coating	Misc. Manufacturing	Total: All Solvent Types
2401100000	Solvent Utilization	Surface Coating	Industrial Maintenance Coatings	Total: All Solvent Types

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2401200000	Solvent Utilization	Surface Coating	Other Special Purpose Coatings	Total: All Solvent Types
2415000000	Solvent Utilization	Degreasing	All Processes/All Industries	Total: All Solvent Types
2425000000	Solvent Utilization	Graphic Arts	All Processes	Total: All Solvent Types
2460100000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Personal Care Products	Total: All Solvent Types
2460200000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Household Products	Total: All Solvent Types
2460400000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Total: All Solvent Types
2460600000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Total: All Solvent Types
2460800000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All FIFRA Related Products	Total: All Solvent Types
2460500000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	All Coatings and Related Products	Total: All Solvent Types
2460900000	Solvent Utilization	Misc. Non-industrial: Consumer and Commercial	Misc. Products	Total: All Solvent Types
2420000000	Solvent Utilization	Dry Cleaning	All Processes	Total: All Solvent Types

## B. Overview of Calculations

The emissions from solvent use are calculated based on national-level data on solvent use from the Freedonia Group. This data is used to develop emissions factors per capita, per employee, or per lane mile of highway, depending on the SCC. The emissions factors are used to estimate VOC emissions in each county. HAP emissions are estimated using the VOC emissions and HAP speciation factors. Because the data from Freedonia is for total solvent use, point source emissions must be subtracted to estimate the nonpoint source emissions. The activity data for solvent use is discussed in section C. The process for allocating activity data to the county level is discussed in section D. The method for developing the emissions factors is discussed in section E. The emissions calculation methods are discussed in section G. The method for subtracting point source emissions data is discussed in section H.

## C. Activity Data

The activity data for solvent utilization varies by SCC; it is based on population data from the U.S. Census Bureau, lane miles data from the Federal Highway Administration, or employment data from the U.S. Census Bureau.

### Population

The activity data for the categories listed in Table 1 are based on county-level population data. Population data are from the U.S. Census Bureau's population estimates for 2017.<sup>1</sup>

**Table 1. Source Categories That Use Population Activity Data**

SCC	Description
2401001000	Architectural Coatings
2401100000	Industrial Maintenance Coatings
2401200000	Other Special Purpose Coatings
2460100000	All Personal Care Products
2460200000	All Household Products
2460400000	All Automotive Aftermarket Products
2460600000	All Adhesives and Sealants
2460800000	All FIFRA Related Products
2460500000	All Coatings and Related Products
2460900000	Misc. Products

**Lane Miles**

County-level lane mile data are used as activity data for one source category (Table 2). The Federal Highway Administration (FHWA) provides state-level lane mile data yearly as part of the Highway Statistics Report.<sup>2</sup> State-level data is allocated to the county level using population data. The process used to distribute the state-level lane miles data to the counties is discussed in section D.

**Table 2. Source Categories That Use Lane Mile Activity Data**

SCC	Description
2401008000	Traffic Markings

**Employment Data**

The source categories listed in Table 3 use county-level employment data as activity data. Employment data are provided by the U.S. Census Bureau's 2014 County Business Patterns (CBP).<sup>3</sup>

**Table 3. Source Categories That Use Employment Activity Data**

SCC	Description	NAICS
2401005000	Auto Refinishing	81112, 4411, 4412
2401015000	Factory Finished Wood	321
2401020000	Wood Furniture	337110, 337121, 337122, 337127*, 337211, 337212, 337215*
2401025000	Metal Furniture	337124, 337127*, 337214, 337215*
2401030000	Paper	322220
2401040000	Metal Cans	33243

SCC	Description	NAICS
2401055000	Machinery and Equipment	3331, 3332, 3333, 33341
2401060000	Large Appliances	3352
2401065000	Electronics and Other Electrical	331318, 331420, 331491, 335921, 335929, 335311
2401070000	Motor Vehicles	3361, 3362, 3363
2401075000	Aircraft	3364
2401085000	Railroad	3365
2401080000	Marine	3366, 488390
2401090000	Misc. Manufacturing	339, 3369
2415000000	Degreasing: All Processes/All Industrial	331, 332, 333, 334, 335, 336, 337, 339, 441, 483, 484, 485, 488, 8111, 8112
2425000000	Graphic Arts	32311, 322211, 322212, 322219, 322220, 322230, 322291, 322299
2420000000	Dry Cleaning	812320

\*Employment data is split equally between Wood Furniture and Metal Furniture Source Categories

Employment data for select NAICS codes and counties must be allocated based on state-level data. The process used to distribute the state-level amount employment data to the counties is discussed in section D.

## D. Allocation Procedure

### Lane Miles

Lane miles data is published yearly by FHWA at the state-level. Population data is used to allocate the state-level data to the county-level. In order to allocate the state-level data, a fraction of county to state-level population is created.

$$PFrac_c = \frac{P_c}{P_{st}} \quad (1)$$

Where:

$PFrac_c$  = Population fraction for county  $c$   
 $P_c$  = Population of county  $c$   
 $P_{st}$  = Population of state  $st$  where county  $c$  is located

This fraction is then applied to the state-level lane miles data to estimate county-level lane miles.

$$LM_c = PFrac_c \times LM_{st} \quad (2)$$

Where:

$LM_c$  = Lane-miles in county  $c$   
 $PFrac_c$  = Population fraction for county  $c$   
 $LM_{st}$  = Lane miles in state  $st$  where county  $c$  is located

## Employment Data

Employment data are from the U.S. Census Bureau's 2014 CBP. Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given North American Industrial Classification Standard (NAICS) code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one business per NAICS code, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 322220.

To gap-fill withheld state-level employment data:

- a. State-level data for states with known employment in NAICS 322220 are summed to the national level.
- b. The total sum of state-level known employment from step a is subtracted from the national total reported employment for NAICS 322220 in the national-level CBP to determine the employment total for the withheld states.
- c. Each of the withheld states is assigned the midpoint of the range code reported for that state. Table 4 lists the range codes and midpoints.
- d. The midpoints for the states with withheld data are summed to the national-level.
- e. An adjustment factor is created by dividing the number of withheld employees (calculated in step b of this section) by the sum of the midpoints (step d).
- f. For the states with withheld employment data, the midpoint of the range for that state (step c) is multiplied by the adjustment factor (step e) to calculate the adjusted state-level employment for landfills.

These same steps are then followed to fill in withheld data in the county-level business patterns.

- g. County-level data for counties with known employment are summed by state.
- h. County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
- i. Each of the withheld counties is assigned the midpoint of the range code (Table 4).
- j. The midpoints for the counties with withheld data are summed to the state level.
- k. An adjustment factor is created by dividing the number of withheld employees (step h) by the sum of the midpoints (step j).
- l. For counties with withheld employment data, the midpoints (step i) are multiplied by the adjustment factor (step k) to calculate the adjusted county-level employment for landfills.

**Table 4. Ranges and midpoints for data withheld from state and county business patterns**

Employment Code	Ranges	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000
M	100,000+	

For example, take the 2014 CBP data for NAICS 322220 (paper bag and coated and treated paper manufacturing) in Kentucky provided in Table 5.

**Table 5. 2014 County Business Pattern for NAICS 322220 in Kentucky**

State FIPS	County FIPS	County Name	NAICS	Employment Code	Employment
21	015	Boone	322220	F	withheld
21	041	Carroll	322220	B	withheld
21	097	Harrison	322220	F	withheld
21	111	Jefferson	322220		391
21	117	Kenton	322220	A	withheld
21	211	Shelby	322220		338
21	213	Simpson	322220	F	withheld
21	219	Todd	322220	B	withheld

*Note:* Counties in Kentucky that do not have employment in paper bag and coated and treated paper manufacturing are excluded from this table.

1. The total number of known county-level employees in Kentucky is 729.
2. The state-level CBP reports 2,517 employees for NAICS 322220 in Kentucky. This means there are 1,788 employees total for the 6 counties for which data are withheld.
3. The counties with withheld data are assigned midpoints according to their employment code in Table 4. For example, Carroll County is given a midpoint of 60 employees (since range code B is 20-99) and Kenton County is given a midpoint of 10 employees.
4. The state total of the midpoints for all withheld counties is 2,380 employees.
5. The adjustment factor is  $1,788/2,380 = 0.7513$ .
6. The adjusted employment for Carroll County is  $60 \times 0.7513 = 45$ . Kenton County has an adjusted employment of  $10 \times 0.7513 = 8$  employees.

## E. Emissions Factors

Emissions factors for most solvent utilization categories are based on national-level estimates of solvent usage from the Freedonia Group.<sup>4</sup> The Freedonia data includes historical usage of solvents in 2015 and projected solvent usage for 2020. Assuming a linear change in solvent demand, EPA estimated solvent usage for 2017 (Table 6).

**Table 6. Solvent Usage in the US**

Description	Solvent Usage (Million Pounds)		
	2015	2017	2020
Paints & Coatings Solvent Demand: Architectural	735	777	840
Paints & Coatings Solvent Demand: Other	1,318	1,321	1,325
Printing Ink Solvent Demand	1,132	1,134	1,138
Cleaning Products Solvent Demand: Household	653	657	662
Cleaning Products Solvent Demand: Industrial & Institutional	385	390	398
Cosmetics & Toiletries Solvent Demand	628	645	670
Adhesives & Sealants Solvent Demand	572	600	643

Description	Solvent Usage (Million Pounds)		
	2015	2017	2020
Transportation Solvent Demand: Motor Vehicles	61	62	64
Dry Cleaning	20	18	16

Source: The Freedonia Group

Table 14, in the appendix, shows a crosswalk between the source categories and the data used to calculate their emissions factors. Some categories, such as personal care products, use only the Freedonia Group data. For these categories, the emissions factor is calculated by dividing the total amount of solvent used by the categories' activity data.

$$EF_s = \frac{F_s \times 1,000,000}{A_s} \quad (3)$$

Where:

- $EF_s$  = Emissions factor for source category  $s$
- $F_s$  = The Freedonia Group data for source category  $s$ , in million pounds per year
- $A_s$  = National-level activity data for source category  $s$ , either population, lane miles, or employment

Freedonia data does not include usage estimates for all surface coating categories, therefore, additional data is used to allocate the non-architectural solvent data to the SCC level. A previous version of this methodology used data from the U.S. Census Bureau's report on Paint and Allied Products to determine solvent use from surface coating, but this report was not produced after 2010.<sup>5</sup> EPA grew the 2010 data from the most recent version of this report to estimate solvent use for surface coating in 2017. The estimated 2017 value is used to calculate the fraction of non-architectural coating use from each source category for surface coating. This fraction is then applied to total non-architectural solvent demand from the Freedonia Group to calculate 2017 solvent use for surface coating categories.

To grow the 2010 Paint and Allied Products data to 2017, EPA uses the U.S. Census Bureau's Annual Survey of Manufactures data on the value of paint shipments in 2010 and 2016.<sup>6\*</sup> Using the relevant product codes (see Table 7), the value of paint shipments are summed for each category for 2010 and 2016. There are not corresponding product codes for all surface coating SCCs; in these cases, the general paint and coating manufacturing data are used. The 2016 value of shipments for each category are converted to 2010 USD by multiplying by 0.9075, a conversion factor from the U.S. Bureau of Labor Statistics.<sup>7</sup>

$$TS_{s,y} = \sum_{NAICS} VS_y \quad (4)$$

$$TS_{s,2016c} = TS_{s,2016} \times 0.9075 \quad (5)$$

Where:

- $TS_{s,y}$  = Total value of shipments for source category  $s$  in year in year  $y$ , in thousand dollars
- $VS_y$  = Value of shipments in year  $y$ , in thousand dollars
- $NAICS$  = NAICS codes corresponding to source category  $s$
- $TS_{s,2016c}$  = Total value of shipments for source category  $s$  in 2016, converted to 2010 USD

A ratio of the 2010 value of shipments, from the Survey of Manufactures, to 2010 volume of paint, from the Paint and Allied Products report, was then used with the converted 2016 value of shipments to estimate the 2016 volume

\* At the time of the publication of this methodology, 2016 was the most recent data year published.

of paint.

$$VP_{s,2016} = TS_{s,2016c} \times \frac{VP_{s,2010}}{TS_{s,2010}} \quad (6)$$

Where:

- $VP_{s,2016}$  = Volume of paint for source category  $s$  in 2016, in thousand gallons
- $TS_{s,2016c}$  = Total value of shipments for source category  $s$  in 2016, converted to 2010 USD
- $VP_{s,2010}$  = Volume of paint for source category  $s$  in 2010, in thousand gallons
- $TS_{s,2010}$  = Total value of shipments for source category  $s$  in 2010, in thousand dollars

The estimated volume of paint in 2016 is then used to create a 2016 to 2010 paint ratio (Table 7). The paint ratio represents the fraction change in surface coating solvent use in each source category between 2010 and 2016. For example, a paint ratio greater than 1 means there was an increase in solvent use in that source category between 2010 and 2016.

$$PR_s = \frac{VP_{s,2016}}{VP_{s,2010}} \quad (7)$$

Where:

- $PR_s$  = 2016-2010 Paint Ratio
- $VP_{s,2016}$  = Volume of paint for source category  $s$  in 2016, in thousand gallons
- $VP_{s,2010}$  = Volume of paint for source category  $s$  in 2010, in thousand gallons

**Table 7. 2016-2010 Paint Ratio**

Product Codes	Description	Paint Ratio
325510	Paint and coating manufacturing	1.246
321	Wood Products	1.327
337	Furniture	1.196
32222/32220	Paper bag and coated and treated paper manufacturing	0.981
332431 & 332439	Metal Can and Container Manufacturing	0.835
3352	Household Appliances	1.121
3361	Motor Vehicle Manufacturing	1.513
3364	Aircraft Manufacturing	1.262
336510	Railroad rolling stock manufacturing	1.461
3366	Boat Manufacturing	1.088
339	Misc. Manufacturing	0.929
3331, 3332, 3333, 33341	Machinery Manufacturing	0.901
335921, 335929, 335311	Electronics Manufacturing	0.944

The paint ratios are multiplied by the volume of paint sold in 2010 from the Paint and Allied Products report for each SCC to estimate the volume of paint sold in 2017.

$$VP_{s,2017} = PR_s \times VP_{s,2010} \quad (8)$$

Where:

- $VP_{s,2017}$  = Volume of paint for source category  $s$  in 2017, in thousand gallons
- $PR_s$  = 2016-2010 Paint Ratio for source category  $s$ , from Table 7
- $VP_{s,2010}$  = Volume of paint for source category  $s$  in 2010, in thousand gallons

The total amount of non-architectural coatings from the Paint and Allied Products data is also calculated in order to estimate the fraction of non-architectural coatings for each SCC. The report includes data on the total amount of coatings sold in 2010, as well as the amount of architectural and powder coatings sold; these values are subtracted

from the total to estimate the volume of non-architectural coatings (Table 8). These values are adjusted to 2017 using the paint and coating manufacturing paint ratio.

$$NAC_{2017} = (TC_{2010} - AC_{2010} - PC_{2010}) \times PR_{\text{paint and coatings}} \quad (9)$$

Where:

$NAC_{2017}$	=	Volume of non-architectural coatings sold in 2017, in gallons
$TC_{2010}$	=	Total volume of coatings sold in 2010, in gallons
$AC_{2010}$	=	Volume of architectural coatings sold in 2010, in gallons
$PC_{2010}$	=	Volume of powder coatings sold in 2010, in gallons
$PR_{\text{paint and coatings}}$	=	Paint ratio for paint and coating manufacturing, from Table 7

**Table 8. Coatings Sold in 2010**

Type of Coating	Amount Sold in 2010 (Gallons)
Volume of Total Coatings Sold	1,301,333,355
Volume of Architectural Coatings	651,626,800
Volume of Powder Coatings	75,774,600
Volume of Non-architectural Coatings	573,931,955

Source: U.S. Census Bureau

The volume of paint sold in 2017 for each SCC (from equation 8) is then divided by the total volume of non-architectural coatings to estimate the fraction of non-architectural paint from each SCC. This fraction is then multiplied by the volume of solvent demand from “paints and coatings: other” for 2017 from Freedonia.

$$NAFrac_s = \frac{VP_{s,2017} \times 1000}{NAC_{2017}} \quad (10)$$

$$SD_{s,2017} = NAFrac_s \times Oth_{2017} \quad (11)$$

Where:

$NAFrac_s$	=	Fraction of non-architectural coatings from source category $s$
$VP_{s,2017}$	=	Volume of paint for source category $s$ in 2017, in thousand gallons
$NAC_{2017}$	=	Volume of non-architectural coatings sold in 2017, in gallons
$SD_{s,2017}$	=	Solvent demand for source category $s$ in 2017, in million pounds
$Oth_{2017}$	=	Other paint and coatings solvent demand in 2017 from Freedonia, in million pounds

After solvent use is estimated for each surface coating category, equation 3 is used to calculate the emissions factor for each SCC.

There are three exceptions to this method for surface coating solvents: aircraft coatings, railroad coatings, and other special purpose coatings. Data for solvent use for other special purpose coatings is not available in the 2010 version of the Paint and Allied Products Report. Therefore data for special purpose coatings from the 2006 version of the report was pulled forward and adjusted to 2017 using the same method as reported above.

The Paint and Allied Products report also aggregates aircraft and railroad coatings in the “other transportation equipment finishes” category. The 2010 volume of paint is grown to 2017 and used to determine solvent demand by the same method as described above. Solvent demand for the other transportation category was then divided in half and assigned equally to the aircraft and railroad SCCs.

Emissions factors for the three Consumer and Commercial categories—including FIFRA related products, coatings and related products, and misc. products—are not estimated by using Freedonia data, but rather come from EPA’s Air Emissions Inventory Improvement Program (EIIP).<sup>8</sup>

The architectural coatings, industrial maintenance coatings, and consumer solvents source categories have controlled

emissions factors that are used for states that have enacted regulations to control the VOC emissions from these types of solvents. These controlled emissions factors are discussed in section F.

VOC emissions factors for all SCCs in this category are listed in Table 9.

**Table 9. VOC Emissions Factors for Solvent Utilization**

SCC	Description	Pollutant Code	Emissions Factor	Unit	Activity Data	Source
2401001000	Architectural Coatings	VOC	2.36	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2401001000	Architectural Coatings (controlled)	VOC	1.88	LB/EACH	Pop.	ERTAC, U.S. Census Bureau
2401005000	Auto Refinishing	VOC	75.58	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401008000	Traffic Markings	VOC	9.80	LB/EACH	Lane Miles	Freedonia Group, U.S. Census Bureau
2401015000	Factory Finished Wood	VOC	44.71	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401020000	Wood Furniture	VOC	282.87	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401025000	Metal Furniture	VOC	769.02	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401030000	Paper	VOC	398.22	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401040000	Metal Cans	VOC	2,239.43	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401055000	Machinery and Equipment	VOC	34.28	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401060000	Large Appliances	VOC	168.96	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401065000	Electronic and Other Electrical	VOC	15.58	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401070000	Motor Vehicles	VOC	160.31	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401075000	Aircraft	VOC	15.40	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401085000	Railroad	VOC	212.90	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401080000	Marine	VOC	176.75	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401090000	Misc. Manufacturing	VOC	69.99	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2401100000	Industrial Maintenance Coatings	VOC	0.36	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2401100000	Industrial Maintenance Coatings (controlled)	VOC	0.15	LB/EACH	Pop.	ERTAC, U.S. Census Bureau
2401200000	Other Special Purpose Coatings	VOC	0.01	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2415000000	Degreasing: All Processes/All Industries	VOC	32.36	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2425000000	Graphic Arts	VOC	1,583.65	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau
2460100000	All Personal Care Products	VOC	1.96	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2460100000	All Personal Care Products (controlled)	VOC	1.15	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460200000	All Household Products	VOC	1.99	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau

SCC	Description	Pollutant Code	Emissions Factor	Unit	Activity Data	Source
2460200000	All Household Products (controlled)	VOC	1.17	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460400000	All Automotive Aftermarket Products	VOC	0.19	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2460400000	All Automotive Aftermarket Products (controlled)	VOC	0.11	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460600000	All Adhesives and Sealants	VOC	1.82	LB/EACH	Pop.	Freedonia Group, U.S. Census Bureau
2460600000	All Adhesives and Sealants (controlled)	VOC	1.07	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460800000	All FIFRA Related Products	VOC	1.78	LB/EACH	Pop.	EIIP, III:5, Table 5.4-1
2460800000	All FIFRA Related Products (controlled)	VOC	1.05	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460500000	All Coatings and Related Products	VOC	0.95	LB/EACH	Pop.	EIIP, III:5, Table 5.4-1
2460500000	All Coatings and Related Products (controlled)	VOC	0.56	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2460900000	Misc. Products	VOC	0.07	LB/EACH	Pop.	EIIP, III:5, Table 5.4-1
2460900000	Misc. Products (controlled)	VOC	0.04	LB/EACH	Pop.	Ozone Transport Commission, U.S. Census Bureau
2420000000	Dry Cleaning	VOC	20.40	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau*
2420000000	Dry Cleaning	127184	118.35	LB/EACH	Emp.	Freedonia Group, U.S. Census Bureau*

\* Dry cleaning emissions factor assumes that 85 percent of dry cleaning solvents are perchloroethylene, which are not considered VOCs. (<https://greenamerica.org/green-living/green-dry-cleaning>)

## F. Controls

Some states have regulations that limit the VOC content of solvent-containing products that are sold. In this methodology, these controls are taken into account where appropriate by using the controlled emissions factors shown in Table 9. In particular, the emissions factors for architectural coatings and industrial maintenance coatings are reduced for the states listed in Table 10, based on calculations done for the 2011 National Emissions Inventory by the Eastern Regional Technical Advisory Committee (ERTAC).

In addition, EPA developed controlled emissions factors for the consumer solvent categories, including personal care products, household products, automotive aftermarket products, adhesives and sealants, FIFRA regulated products, coatings, and miscellaneous consumer products. The controlled emissions factors were taken from the Ozone Transport Commission, based on emissions factors for states that had implemented model rules for consumer solvents.<sup>9</sup> Note that the Ozone Transport Commission includes a single emissions factor for all consumer solvents (5.15 lbs./person), while EPA uses individual emissions factors for each of the seven consumer solvent categories. To estimate controlled emissions factors for the individual solvent categories, the uncontrolled emissions factors were scaled so that the sum of the factors equaled 5.15 lbs./person.

**Table 10. States for which controlled emissions factors are used.**

State	Architectural Coatings	Industrial Maintenance Coatings	Consumer Solvents
AZ	✓	✓	
CA	✓	✓	✓

State	Architectural Coatings	Industrial Maintenance Coatings	Consumer Solvents
CT	✓	✓	✓
DE	✓	✓	✓
DC	✓	✓	✓
ME	✓	✓	✓
MD	✓	✓	✓
MA	✓	✓	✓
NH	✓	✓	✓
NJ	✓	✓	✓
NY	✓	✓	✓
PA	✓	✓	✓
RI	✓	✓	✓
TX	✓	✓	
VT	✓	✓	
VA	✓	✓	✓

The solvent tool also allows users to adjust emissions factors to account for controls and to implement a county-level control factor.

## G. Emissions

Total VOC emissions from solvent utilization are calculated by multiplying the activity data for the source category by the calculated emissions factor for that category.

$$E_{VOC,c,s} = A_{c,s} \times EF_{VOC,s} \quad (12)$$

Where:

- $E_{VOC,c,s}$  = Annual VOC emissions in county  $c$  for source category  $s$ , in tons per year
- $A_{c,s}$  = Activity data for county  $c$  associated with source category  $s$
- $EF_{VOC,s}$  = Calculated VOC emissions factor for source category  $s$

HAP emissions are estimated using the VOC emissions and HAP speciation factors shown in Table 11. This step is completed after the point source subtraction step discussed in section H.

$$E_{p,c,s} = E_{VOC,c,s} \times SF_{p,s} \quad (13)$$

Where:

- $E_{p,c,s}$  = Annual emissions of HAP  $p$  county  $c$  for source category  $s$ , in tons per year
- $E_{VOC,c,s}$  = Annual VOC emissions in county  $c$  for source category  $s$ , in tons per year
- $SF_{p,s}$  = Speciation factor for HAP  $p$  for source category  $s$

**Table 11. HAP speciation factors for solvent use.**

<b>SCC</b>	<b>Pollutant Code</b>	<b>Pollutant Description</b>	<b>Speciation Factor</b>
2401001000	123911	1,4-Dioxane (1,4-Diethyleneoxide)	0.00002
2401001000	584849	2,4-Toluene diisocyanate	0.00002
2401001000	101688	4,4'-Methylenediphenyl diisocyanate (MDI)	0.00014
2401001000	75070	Acetaldehyde	0.0001
2401001000	117817	Bis(2-ethylhexyl)phthalate (DEHP)	0.00003
2401001000	98828	Cumene	0.00038
2401001000	84742	Dibutyl phthalate	0.00002
2401001000	131113	Dimethyl phthalate	0.00001
2401001000	100414	Ethylbenzene	0.00248
2401001000	107211	Ethylene glycol	0.05049
2401001000	50000	Formaldehyde	0.00002
2401001000	171	Glycol Ethers	0.02065
2401001000	110543	Hexane	0.00015
2401001000	67561	Methanol	0.012184699
2401001000	80626	Methyl methacrylate	0.00012
2401001000	108101	Methyl isobutyl ketone(Hexone)	0.000980163
2401001000	91203	Naphthalene	0.00046
2401001000	100425	Styrene	0.00102
2401001000	108883	Toluene	0.0397
2401001000	121448	Triethylamine	0.00006
2401001000	108054	Vinyl acetate	0.00012
2401001000	1330207	Xylenes (mixed isomers)	0.0034
2401005000	107211	Ethylene glycol	0.0016
2401005000	171	Glycol Ethers	0.00953
2401005000	108101	Methyl isobutyl ketone (Hexone)	0.0103
2401005000	108883	Toluene	0.018
2401005000	1330207	Xylenes (mixed isomers)	0.0034
2401015000	171	Glycol Ethers	0.01382
2401015000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401015000	108883	Toluene	0.0397
2401015000	1330207	Xylenes (mixed isomers)	0.0034
2401100000	171	Glycol Ethers	0.01382
2401100000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401100000	108883	Toluene	0.0397
2401100000	1330207	Xylenes (mixed isomers)	0.0034
2401200000	171	Glycol Ethers	0.01382
2401200000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401200000	108883	Toluene	0.0397

SCC	Pollutant Code	Pollutant Description	Speciation Factor
2401200000	1330207	Xylenes (mixed isomers)	0.0034
2401090000	171	Glycol Ethers	0.01382
2401090000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401090000	108883	Toluene	0.0397
2401090000	1330207	Xylenes (mixed isomers)	0.0034
2401080000	171	Glycol Ethers	0.01382
2401080000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401080000	108883	Toluene	0.0397
2401080000	1330207	Xylenes (mixed isomers)	0.0034
2401085000	171	Glycol Ethers	0.01382
2401085000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401085000	108883	Toluene	0.0397
2401085000	1330207	Xylenes (mixed isomers)	0.0034
2401075000	171	Glycol Ethers	0.01382
2401075000	108101	Methyl isobutyl ketone(Hexone)	0.0397
2401075000	108883	Toluene	0.0397
2401075000	1330207	Xylenes (mixed isomers)	0.0034
2401070000	171	Glycol Ethers	0.01382
2401070000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401070000	108883	Toluene	0.0397
2401070000	1330207	Xylenes (mixed isomers)	0.0034
2401065000	171	Glycol Ethers	0.01382
2401065000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401065000	108883	Toluene	0.0397
2401065000	1330207	Xylenes (mixed isomers)	0.0034
2401060000	171	Glycol Ethers	0.01382
2401060000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401060000	108883	Toluene	0.0397
2401060000	1330207	Xylenes (mixed isomers)	0.0034
2401055000	171	Glycol Ethers	0.01382
2401055000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401055000	108883	Toluene	0.0397
2401055000	1330207	Xylenes (mixed isomers)	0.0034
2401040000	171	Glycol Ethers	0.01382
2401040000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401040000	108883	Toluene	0.0397
2401040000	1330207	Xylenes (mixed isomers)	0.0034
2401030000	171	Glycol Ethers	0.01382
2401030000	108101	Methyl isobutyl ketone(Hexone)	0.0103

SCC	Pollutant Code	Pollutant Description	Speciation Factor
2401030000	108883	Toluene	0.0397
2401030000	1330207	Xylenes (mixed isomers)	0.0034
2401025000	171	Glycol Ethers	0.01382
2401025000	108101	Methyl isobutyl ketone(Hexone)	0.0103
2401025000	108883	Toluene	0.0397
2401025000	1330207	Xylenes (mixed isomers)	0.0034
2401008000	108883	Toluene	0.0397
2401008000	1330207	Xylenes (mixed isomers)	0.0034
2415000000	108883	Toluene	0.078204196
2460900000	67561	Methyl Alcohol	0.0933
2460900000	108883	Toluene	0.00268
2460800000	67561	Methyl Alcohol	0.0933
2460800000	108883	Toluene	0.003221139
2460600000	67561	Methyl Alcohol	0.0933
2460600000	108883	Toluene	0.003221139
2460500000	67561	Methyl Alcohol	0.0933
2460500000	108883	Toluene	0.00268
2460400000	107211	Ethylene Glycol	0.1595
2460400000	67561	Methyl Alcohol	0.0933
2460400000	108883	Toluene	0.00268
2460200000	67561	Methyl Alcohol	0.0933
2460200000	108883	Toluene	0.003221139
2460100000	67561	Methyl Alcohol	0.0933
2460100000	108883	Toluene	0.003529334
2460000000	67561	Methyl Alcohol	0.0933
2460000000	108883	Toluene	0.00268
2425000000	67561	Methyl Alcohol	0.02634987
2425000000	108101	Methyl Isobutyl Ketone	0.0004259
2425000000	108883	Toluene	0.0397
2425000000	1330207	Xylene	0.0034
2401015000	107211	Ethylene glycol	0.0045
2401100000	107211	Ethylene glycol	0.0045
2401200000	107211	Ethylene glycol	0.0045
2401090000	107211	Ethylene glycol	0.0045
2401080000	107211	Ethylene glycol	0.0045
2401085000	107211	Ethylene glycol	0.0045
2401075000	107211	Ethylene glycol	0.0045
2401070000	107211	Ethylene glycol	0.0045
2401065000	107211	Ethylene glycol	0.0045

SCC	Pollutant Code	Pollutant Description	Speciation Factor
2401060000	107211	Ethylene glycol	0.0045
2401055000	107211	Ethylene glycol	0.0045
2401040000	107211	Ethylene glycol	0.0045
2401030000	107211	Ethylene glycol	0.0045
2401025000	107211	Ethylene glycol	0.0045
2415000000	110543	N-hexane	0.000057282
2415000000	111773	Methyl carbitol (2-(2-methoxyethoxy)ethanol) (degme)	0.019346982
2415000000	112345	2-(2-butoxyethoxy)ethanol (butyl carbitol)	0.03330946
2415000000	127184	Perchloroethylene (Tetrachloroethylene)	0.010597163
2415000000	1330207	Xylenes (Mixed Isomers)	0.087841886
2415000000	67561	Methyl alcohol (methanol)	0.050236279
2415000000	71432	Benzene	0.001432049
2415000000	71556	1,1,1-trichloroethane	0.053014454
2415000000	75092	Dichloromethane (methylene chloride)	0.00614349
2415000000	79016	Trichloroethylene	0.030201913
2415000000	86748	Carbazole	0.001074037
2415000000	91203	Naphthalene	4.29615E-05
2415000000	98828	Isopropylbenzene (or cumene; 2-Phenylpropane)	4.29615E-05

## H. Point Source Subtraction

Point source subtraction is necessary for this category to ensure that solvent emissions are not double-counted with the point source inventory. In order to accomplish this, nonpoint source solvent SCCs must be linked to corresponding point SCCs, using point source emissions data supplied by state, local, or tribal (SLT) agencies and a point-nonpoint source crosswalk, shown in Table 14 in the appendix.

Point source subtraction should be completed at the county level using *uncontrolled* point source emissions.<sup>†</sup>

$$NP_{s,c} = TE_{s,c} \times PS_{s,c} \quad (14)$$

Where:

- $NP_{s,c}$  = Nonpoint source solvent emissions in county  $c$  for source category  $s$ , in tons per year
- $TE_{s,c}$  = Total solvent emissions  $s$  in county  $c$  for source category  $s$ , in tons per year
- $PS_{s,c}$  = Point source solvent emissions in county  $c$  for source category  $s$ , in tons per year

If county-level data is not available, state-level emissions can be allocated to the county level using population or employment data.

Note that if point source subtraction results in a negative number because the point source emissions from solvents

<sup>†</sup> There is one point source category for Adhesives and Sealants (40200710) that maps to the nonpoint Adhesives and Sealants category (2460600000). The Solvents methodology assumes that emissions from the nonpoint Adhesives and Sealants category are controlled in some states, as discussed in section F. However these controls are specific to consumer solvents, rather than the types of solvents likely used by point sources. Therefore, EPA still recommends subtracting *uncontrolled* point source emissions for this source category.

are larger than the estimated total emissions from solvents, the Solvent Tool will zero out emissions for that source category in that county.

After point source subtraction, the HAP emissions are speciated from the estimated nonpoint source VOC emissions, as discussed in section G.

## I. Sample Calculations

Table 12 lists sample calculations to determine the VOC emissions from traffic coating solvent utilization in Apache County, Arizona.

**Table 12. Sample calculations for VOC emissions from solvent utilization in Apache County, AZ.**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$P_{Frac_c} = \frac{P_c}{P_{st}}$	$\frac{71,606 \text{ people in Apache County}}{7,016,270 \text{ people in Arizona}}$	0.0102 share of the population of Arizona in Apache County
2	$LM_c = P_{Frac_c} \times LM_{st}$	$0.0102 \times 144,959 \text{ lane miles in Arizona}$	1,479 lane miles in Apache County
3	$EF_s = \frac{F_s \times 1,000,000}{A_s}$	N/A	Equation 3 is not used at this point in the method for traffic coatings
4	$TS_{s,y} = \sum_{NAICS} VS_y$	Product code 325510 is used for traffic coatings	2010 value of shipments is 19,994,229 thousand USD. 2016 value of shipments is 27,445,132 thousand USD
5	$TS_{s,2016c} = TS_{s,2016} \times 0.9075$	$27,445,132 \text{ thous. USD} \times 0.9075$	Value of 2016 paint shipments in 2010 USD is 24,906,457 thousand USD
6	$VP_{s,2016} = TS_{s,2016c} \div \frac{TS_{s,2010}}{VP_{s,2010}}$	$24,906,457 \text{ thous. USD} \div \frac{19,994,229 \text{ thous. USD}}{1,301,333 \text{ thous. gal. paint}}$	1,621,048 thousand gallons of paint sold in 2016
7	$PR_s = \frac{VP_{s,2016}}{VP_{s,2010}}$	$\frac{1,621,048 \text{ thous. gal. of paint in 2016}}{1,301,333 \text{ thous. gal. of paint in 2010}}$	1.246 ratio of 2016 to 2010 paint
8	$VP_{s,2017} = PR_s \times VP_{s,2010}$	$1.246 \times 37,335 \text{ thous. gal. traffic coatings sold in 2010}$	46,508 thousand gallons of traffic coatings sold in 2017
9	$NAC_{2017} = (TC_{2010} - AC_{2010} - PC_{2010}) \times PR_{\text{paint and coatings}}$	$(1,301,333,355 \text{ gal.} - 651,626,800 \text{ gal.} - 75,774,600 \text{ gal.}) \times 1.246$	714,936,882 gallons of non-architectural coatings sold in 2017
10	$NAFrac_s = \frac{VP_{s,2017} \times 1000}{NAC_{2017}}$	$\frac{46,508 \text{ thous. gal. traffic coatings} \times 1000}{714,936,882 \text{ gal. non - arch. coatings}}$	6.5% of non-architectural coatings sold in 2017 are traffic coatings
11	$SD_{s,2017} = NAFrac_s \times Oth_{2017}$	$6.5\% \times 1,320.80 \text{ mil. lbs. other solvent demand in 2017}$	85.92 million pounds of traffic coating solvent demand in 2017

Eq. #	Equation	Values for Apache County, AZ	Result
3	$EF_s = \frac{F_s \times 1,000,000}{A_s}$	$\frac{85.92 \text{ mil. lbs. traffic coatings sold in 2017} \times 1,000,000}{8,765,578 \text{ lane miles in 2017}}$	9.80 pounds of VOC emitted per lane mile
12	$E_{VOC,s} = A_{c,s} \times EF_{VOC,s}$	$1,479 \text{ lane miles} \times 9.80 \text{ lbs. VOC per lane mile}$	14,498 lbs. of VOC emitted from traffic coatings in Apache County, AZ

## J. Changes from 2014 Methodology

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## K. Puerto Rico and U.S. Virgin Islands Emissions Calculations

Emissions from Puerto Rico are calculated using the same method described above. For the U.S. Virgin Islands, emissions are calculated using 2010 population data,<sup>10</sup> because 2014 Census Data does not exist for the U.S. Virgin Islands.

## L. Instructions for Submitting Point Emissions Data to Input Template

The Solvent Input Template includes a template for submitting point source emissions data. The template includes all point SCCs that map to nonpoint solvent SCCs. These point source emissions should be submitted at the county level. The template does not include all combinations of county FIPS codes and point SCCs in order to limit the file size. Rather, the template contains a single row for each point SCC that maps to a nonpoint solvent SCC. To enter emissions for more than one county, copy the necessary rows to the bottom of the table. There is no need to copy rows for which you will not be submitting point source data. The 5-digit FIPS code must be entered for all counties for which point source emissions data is being submitted.

Point source subtraction should be completed at the county level using *uncontrolled* point source emissions.<sup>‡</sup> Note that if point source subtraction results in a negative number because the point source emissions from solvents are larger than the estimated total emissions from solvents, the Solvent Tool will zero out emissions for that source category in that county.

After point source subtraction, the HAP emissions are speciated from the estimated nonpoint source VOC emissions, as discussed in section G.

<sup>‡</sup> There is one point source category for Adhesives and Sealants (40200710) that maps to the nonpoint Adhesives and Sealants category (2460600000). The Solvents methodology assumes that emissions from the nonpoint Adhesives and Sealants category are controlled in some states, as discussed in section F. However these controls are specific to consumer solvents, rather than the types of solvents likely used by point sources. Therefore, EPA still recommends subtracting *uncontrolled* point source emissions for this source category.

## M. References

- <sup>1</sup> U.S. Census Bureau. Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014, 2017 Populations Estimates, [https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP\\_2014\\_PEPANNRES&prodType=table](https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2014_PEPANNRES&prodType=table)
- <sup>2</sup> Federal Highway Administration. Highway Statistics 2017, . <https://www.fhwa.dot.gov/policyinformation/statistics/2017/>
- <sup>3</sup> U.S. Census Bureau. 2014 County Business Patterns, <http://www.census.gov/data/datasets/2014/econ/cbp/2014-cbp.html>
- <sup>4</sup> The Freedonia Group. 2016. Industry Study #3429, Solvents.
- <sup>5</sup> U.S. Census Bureau. 2010. MA325F: Paints and Allied Products. <https://www.census.gov/data/tables/time-series/econ/cir/ma325f.html>
- <sup>6</sup> U.S. Census Bureau. 2016. Annual Survey of Manufactures. <https://www.census.gov/programs-surveys/asm/data/tables.html>
- <sup>7</sup> U.S. Bureau of Labor Statistics. CPI Inflation Calculator. [https://www.bls.gov/data/inflation\\_calculator.htm](https://www.bls.gov/data/inflation_calculator.htm)
- <sup>8</sup> U.S. Environmental Protection Agency. 1996. Air Emissions Inventory Improvement Program (EIIP), Volume III: Chapter 5 Consumer and Commercial Solvent Use. <https://www.epa.gov/sites/production/files/2015-08/documents/iii05.pdf>
- <sup>9</sup> Ozone Transport Commission. 2016. Technical Support Document for the 2011 Ozone Transport Commission/Mid-Atlantic Northeastern Visibility Union Modeling Platform. Appendix A. <https://otcair.org/document.asp?Fview=Report>
- <sup>10</sup> U.S. Census Bureau, Decennial Censuses, 2010 Census: Summary File 1, [http://www2.census.gov/census\\_2010/04-Summary\\_File\\_1/](http://www2.census.gov/census_2010/04-Summary_File_1/).

**APPENDIX**
**Table 13. Source Category and Data Source Crosswalk for Solvent Utilization**

SCC	SCC Level 2	SCC Level 3	Freedonia	Paint and Allied Products	Annual Survey of Manufactures
2401001000	Surface Coating	Architectural Coatings	Paints & Coatings Solvent Demand: Architectural		
2401005000	Surface Coating	Auto Refinishing	Paints & Coatings Solvent Demand: Other	Automotive, other transportation and machinery refinish paints and enamels, including primers	Paint and coating manufacturing
2401008000	Surface Coating	Traffic Markings	Paints & Coatings Solvent Demand: Other	Traffic marking paints (all types; shelf goods and highway department)	Paint and coating manufacturing
2401015000	Surface Coating	Factory Finished Wood	Paints & Coatings Solvent Demand: Other	Wood and composition board flat stock finishes	Wood Products
2401020000	Surface Coating	Wood Furniture	Paints & Coatings Solvent Demand: Other	Wood furniture, cabinet, and fixture finishes	Furniture
2401025000	Surface Coating	Metal Furniture	Paints & Coatings Solvent Demand: Other	Nonwood furniture and fixture finishes, including business equipment finishes	Furniture
2401030000	Surface Coating	Paper	Paints & Coatings Solvent Demand: Other	Paper, paper board, film, and foil finishes, excluding pigment binders	Paper bag and coated and treated paper manufacturing
2401040000	Surface Coating	Metal Cans	Paints & Coatings Solvent Demand: Other	Container and closure finishes	Metal Can and Container Manufacturing
2401055000	Surface Coating	Machinery and Equipment	Paints & Coatings Solvent Demand: Other	Machinery and equipment finishes, including road building equipment and farm implement	Machinery Manufacturing
2401060000	Surface Coating	Large Appliances	Paints & Coatings Solvent Demand: Other	Appliance, heating equipment, and air-conditioner finishes	Household Appliances
2401065000	Surface Coating	Electronics and Other Electrical	Paints & Coatings Solvent Demand: Other	Electrical insulating coatings	Electronics Manufacturing
2401070000	Surface Coating	Motor Vehicles	Paints & Coatings Solvent Demand: Other	Automobile, light truck, van, and sport utility vehicle finishes & Automobile parts finishes & Heavy duty truck, bus, and recreational vehicle finishes	Motor Vehicle Manufacturing
2401075000	Surface Coating	Aircraft	Paints & Coatings Solvent Demand: Other	Other transportation equipment finishes, including aircraft and railroad	
2401085000	Surface Coating	Railroad	Paints & Coatings Solvent Demand: Other	Other transportation equipment finishes, including aircraft and railroad	
2401080000	Surface Coating	Marine	Paints & Coatings Solvent Demand: Other	Marine paints, ship and off-shore facilities and shelf goods for both new construction and marine refinish and maintenance. Excludes spar varnish & Marine paints for yacht and pleasure craft, new construction, refinish and maintenance	Boat Manufacturing
2401090000	Surface Coating	Misc. Manufacturing	Paints & Coatings Solvent Demand: Other	Other industrial product finishes	Misc. Manufacturing

SCC	SCC Level 2	SCC Level 3	Freedonia	Paint and Allied Products	Annual Survey of Manufactures
2401100000	Surface Coating	Industrial Maintenance Coatings	Paints & Coatings Solvent Demand: Other	Industrial new construction and maintenance paints, interior & Industrial new construction and maintenance paints, exterior	Paint and coating manufacturing
2401200000	Surface Coating	Other Special Purpose Coatings	Paints & Coatings Solvent Demand: Other		
2415000000	Degreasing	All Processes/All Industries	Cleaning Products Solvent Demand: Industrial & Institutional		
2425000000	Graphic Arts	All Processes	Printing Ink Solvent Demand		
2460100000	Misc. Non-industrial: Consumer and Commercial	All Personal Care Products	Cosmetics & Toiletries Solvent Demand		
2460200000	Misc. Non-industrial: Consumer and Commercial	All Household Products	Cleaning Products Solvent Demand: Household		
2460400000	Misc. Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products	Transportation Solvent Demand: Motor Vehicles		
2460600000	Misc. Non-industrial: Consumer and Commercial	All Adhesives and Sealants	Adhesives & Sealants Solvent Demand		
2460800000	Misc. Non-industrial: Consumer and Commercial	All FIFRA Related Products			
2460500000	Misc. Non-industrial: Consumer and Commercial	All Coatings and Related Products			
2460900000	Misc. Non-industrial: Consumer and Commercial	Misc. Products			
2420000000	Dry Cleaning	All Processes			

**Table 14. Point-Nonpoint Crosswalk for Solvent Utilization**

<b>Point SCC</b>	<b>SCC Level One</b>	<b>SCC Level Two</b>	<b>SCC Level Three</b>	<b>SCC Level Four</b>	<b>Nonpoint SCC</b>	<b>Nonpoint Description</b>
30101470	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning	2415000000	Solvent - Degreasing
30101471	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Solvent - Degreasing
30101472	Industrial Processes	Chemical Manufacturing	Paint Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Solvent - Degreasing
30102070	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning	2415000000	Solvent - Degreasing
30102071	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Hand Wipe	2415000000	Solvent - Degreasing
30102072	Industrial Processes	Chemical Manufacturing	Printing Ink Manufacture	Equipment Cleaning: Tanks, Vessels, etc.	2415000000	Solvent - Degreasing
30102426	Industrial Processes	Chemical Manufacturing	Synthetic Organic Fiber	Equipment Cleanup	2415000000	Solvent - Degreasing
30400340	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Grinding/Cleaning	2415000000	Solvent - Degreasing
30400342	Industrial Processes	Secondary Metal Production	Grey Iron Foundries	Casting Cleaning/Chippers	2415000000	Solvent - Degreasing
30400711	Industrial Processes	Secondary Metal Production	Steel Foundries	Cleaning	2415000000	Solvent - Degreasing
30400725	Industrial Processes	Secondary Metal Production	Steel Foundries	Casting Cleaning/Tumblers	2415000000	Solvent - Degreasing
30503701	Industrial Processes	Mineral Products	Coated Abrasives Manufacturing	Printing of Backing	2425000000	Solvent - Graphic Arts
30510005	Industrial Processes	Mineral Products	Bulk Materials Elevators	Cleaning	2415000000	Solvent - Degreasing
30701199	Industrial Processes	Pulp and Paper and Wood Products	Paper Coating and Glazing	Extrusion Coating Line with Solvent Free Resin/Wax	2401030000	Surface Coating: Paper, Film and Foil
30900301	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Brush Cleaning	2415000000	Solvent - Degreasing
30900302	Industrial Processes	Fabricated Metal Products	Abrasive Cleaning of Metal Parts	Tumble Cleaning	2415000000	Solvent - Degreasing
30901101	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Alkaline Cleaning Bath	2415000000	Solvent - Degreasing
30901102	Industrial Processes	Fabricated Metal Products	Conversion Coating of Metal Products	Acid Cleaning Bath (Pickling)	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
31303502	Industrial Processes	Electrical Equipment	Manufacturing - General Processes	Cleaning	2415000000	Solvent - Degreasing
31306501	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Processes: Wet Chemical: Specify Aqueous Solution	2415000000	Solvent - Degreasing
31306502	Industrial Processes	Electrical Equipment	Semiconductor Manufacturing	Cleaning Process: Plasma Process: Specify Gas Used	2415000000	Solvent - Degreasing
31401560	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup	2415000000	Solvent - Degreasing
31401561	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Tools (Other than Spray Guns)	2415000000	Solvent - Degreasing
31401562	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Spray Guns	2415000000	Solvent - Degreasing
31401563	Industrial Processes	Transportation Equipment	Boat Manufacturing	Cleanup: Molds	2415000000	Solvent - Degreasing
31401570	Industrial Processes	Transportation Equipment	Boat Manufacturing	Waste Disposal: Used Cleanup Solvents	2415000000	Degreasing
31612001	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Tank Cleaning Operations	2415000000	Solvent - Degreasing
31612002	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	General Cleaning Operations	2415000000	Solvent - Degreasing
31612003	Industrial Processes	Photographic Film Manufacturing	Support Activities - Cleaning Operations	Parts Cleaning Operations	2415000000	Solvent - Degreasing
33000102	Industrial Processes	Textile Products	Miscellaneous	Printing	2425000000	Solvent - Graphic Arts
40100101	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Perchloroethylene	2420000000	Solvent - Dry Cleaning
40100102	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-01 or 4-10-002-01)	2420000000	Dry Cleaning
40100104	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard (Petroleum Solvent) (Use 4-10-001-02 or 4-10-002-02)	2420000000	Dry Cleaning
40100105	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorotrifluoroethane (Freon)	2420000000	Solvent - Dry Cleaning
40100107	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Ethylene Oxide: General	2420000000	Solvent - Dry Cleaning
40100146	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck(Drained) (Use 4-10-001-61 or 002-61)	2420000000	Solvent - Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100147	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Stoddard:Filtr Disp/Cooked Muck (Centrif) (Use 4-10-001-62 or 002-62)	2420000000	Solvent - Dry Cleaning
40100160	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Washer/Dryer/Still	2420000000	Solvent - Dry Cleaning
40100161	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Cartridge Filter Disposal	2420000000	Solvent - Dry Cleaning
40100162	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Still Residue Disposal	2420000000	Solvent - Dry Cleaning
40100163	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Trichlorofluoroethane: Miscellaneous Fugitive	2420000000	Solvent - Dry Cleaning
40100198	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Other Not Classified	2420000000	Solvent - Dry Cleaning
40100198	Chemical Evaporation	Organic Solvent Evaporation	Dry Cleaning	Other Not Classified	2420000000	Dry Cleaning
40100201	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Open-top Vapor Degreasing	2415000000	Degreasing
40100202	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100203	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100204	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100205	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100206	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100207	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100208	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Chlorosolve: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100209	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Butyl Acetate: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100215	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100221	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): Conveyorized Vapor Degreasing	2415000000	Degreasing
40100222	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): Conveyorized Vapor Degreaser	2415000000	Solvent - Degreasing
40100223	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: Conveyorized Vapor Degreasing	2415000000	Solvent - Degreasing
40100224	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: Conveyorized Vapor Degreasing	2415000000	Solvent - Degreasing
40100225	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: Conveyorized Vapor Degreasing	2415000000	Solvent - Degreasing
40100235	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Vaporized Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100236	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Entire Unit: with Non-boiling Solvent: Conveyorized Vapor Degreasing	2415000000	Degreasing
40100251	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Stoddard (Petroleum Solvent): General Degreasing Units	2415000000	Degreasing
40100252	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	1,1,1-Trichloroethane (Methyl Chloroform): General Degreasing Units	2415000000	Solvent - Degreasing
40100253	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Perchloroethylene: General Degreasing Units	2415000000	Solvent - Degreasing
40100254	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Methylene Chloride: General Degreasing Units	2415000000	Solvent - Degreasing
40100255	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichloroethylene: General Degreasing Units	2415000000	Solvent - Degreasing
40100256	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Toluene: General Degreasing Units	2415000000	Solvent - Degreasing
40100257	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorotrifluoroethane (Freon): General Degreasing Units	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100258	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Trichlorofluoromethane: General Degreasing Units	2415000000	Solvent - Degreasing
40100296	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: General Degreasing Units	2415000000	Solvent - Degreasing
40100298	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Conveyorized Vapor Degreasing	2415000000	Solvent - Degreasing
40100299	Chemical Evaporation	Organic Solvent Evaporation	Degreasing	Other Not Classified: Open-top Vapor Degreasing	2415000000	Solvent - Degreasing
40100301	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methanol	2415000000	Degreasing
40100302	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methylene Chloride	2415000000	Degreasing
40100303	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Stoddard (Petroleum Solvent)	2415000000	Degreasing
40100304	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Perchloroethylene	2415000000	Degreasing
40100305	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	1,1,1-Trichloroethane (Methyl Chloroform)	2415000000	Degreasing
40100306	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Trichloroethylene	2415000000	Degreasing
40100307	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Isopropyl Alcohol	2415000000	Degreasing
40100308	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Methyl Ethyl Ketone	2415000000	Degreasing
40100309	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Freon	2415000000	Degreasing
40100310	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Acetone	2415000000	Degreasing
40100311	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Glycol Ethers	2415000000	Degreasing
40100335	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Entire Unit	2415000000	Degreasing
40100336	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Degreaser: Entire Unit	2415000000	Degreasing
40100399	Chemical Evaporation	Organic Solvent Evaporation	Cold Solvent Cleaning/Stripping	Other Not Classified	2415000000	Degreasing
40100401	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Perchloroethylene	2415000000	Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40100499	Chemical Evaporation	Organic Solvent Evaporation	Knit Fabric Scouring with Chlorinated Solvent	Other Not Classified	2401090000	Surface Coating: Misc. Manufacturing
40188898	Chemical Evaporation	Organic Solvent Evaporation	Fugitive Emissions	General	2415000000	Degreasing
40200101	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Solvent-base	2401090000	Surface Coating: Misc. Manufacturing
40200201	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Paint: Water-base	2401090000	Surface Coating: Misc. Manufacturing
40200706	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: Solvent Mixing	2401090000	Surface Coating: Misc. Manufacturing
40200710	Chemical Evaporation	Surface Coating Operations	Surface Coating Application - General	Adhesive: General	2460600000	Adhesives and sealants
40200801	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40200801	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	General	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200802	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Dried < 175F	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40200803	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Baked : 175F	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40200820	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Prime/Base Coat Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200830	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200840	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Curing Ovens: General (Includes Codes 41, 42, and 43)	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200841	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Base Coat Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200842	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Over Varnish Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200843	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Two Piece Can Interior Body Coat Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200845	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Curing Ovens (Includes Codes 46, 47, 48, and 49)	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200846	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Interior) Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200847	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Base Coat (Exterior) Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200848	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Sheet Lithographic Coating Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200849	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Three Piece Can Interior Body Coat Oven	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40200855	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Filler Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200856	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Sealer Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200861	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Single Coat Application: Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200870	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Color Coat Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200871	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	Topcoat/Texture Coat Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200872	Chemical Evaporation	Surface Coating Operations	Coating Oven - General	EMI/RFI Shielding Coat Oven	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40200901	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	General	2401090000	Surface Coating: Misc. Manufacturing
40200902	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Acetone	2401090000	Surface Coating: Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200903	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Acetate	2401090000	Surface Coating: Misc. Manufacturing
40200904	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Butyl Alcohol	2401090000	Surface Coating: Misc. Manufacturing
40200905	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Carbitol	2401090000	Surface Coating: Misc. Manufacturing
40200906	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve	2401090000	Surface Coating: Misc. Manufacturing
40200907	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Cellosolve Acetate	2401090000	Surface Coating: Misc. Manufacturing
40200908	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Dimethyl Formamide	2401090000	Surface Coating: Misc. Manufacturing
40200909	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Acetate	2401090000	Surface Coating: Misc. Manufacturing
40200910	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethyl Alcohol	2401090000	Surface Coating: Misc. Manufacturing
40200911	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Gasoline	2401090000	Surface Coating: Misc. Manufacturing
40200912	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Alcohol	2401090000	Surface Coating: Misc. Manufacturing
40200913	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Isopropyl Acetate	2401090000	Surface Coating: Misc. Manufacturing
40200914	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Kerosene	2401090000	Surface Coating: Misc. Manufacturing
40200915	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Lactol Spirits	2401090000	Surface Coating: Misc. Manufacturing
40200916	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Acetate	2401090000	Surface Coating: Misc. Manufacturing
40200917	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Alcohol	2401090000	Surface Coating: Misc. Manufacturing
40200918	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Ethyl Ketone	2401090000	Surface Coating: Misc. Manufacturing
40200919	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methyl Isobutyl Ketone	2401090000	Surface Coating: Misc. Manufacturing
40200920	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Mineral Spirits	2401090000	Surface Coating: Misc. Manufacturing
40200921	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Naphtha	2401090000	Surface Coating: Misc. Manufacturing
40200922	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Toluene	2401090000	Surface Coating: Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40200923	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Varsol	2401090000	Surface Coating: Misc. Manufacturing
40200924	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Xylene	2401090000	Surface Coating: Misc. Manufacturing
40200925	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Benzene	2401090000	Surface Coating: Misc. Manufacturing
40200926	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Turpentine	2401090000	Surface Coating: Misc. Manufacturing
40200927	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Hexylene Glycol	2401090000	Surface Coating: Misc. Manufacturing
40200928	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Ethylene Oxide	2401090000	Surface Coating: Misc. Manufacturing
40200929	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	1,1,1-Trichloroethane (Methyl Chloroform)	2401090000	Surface Coating: Misc. Manufacturing
40200930	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Methylene Chloride	2401090000	Surface Coating: Misc. Manufacturing
40200931	Chemical Evaporation	Surface Coating Operations	Thinning Solvents - General	Perchloroethylene	2415000000	Degreasing
40201101	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Operation (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Solvent - Graphic Arts
40201103	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Mixing (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Solvent - Graphic Arts
40201104	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Coating Storage (Also See Specific Coating Method Codes 4-02-04X)	2425000000	Solvent - Graphic Arts
40201105	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Equipment Cleanup: Fabric Coating (Also See Spec Coat Method Codes 4-02-04X)	2415000000	Solvent - Degreasing
40201112	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Roller (Also See New Codes Under 4-02-040-XX)	2425000000	Solvent - Graphic Arts
40201114	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Rotary Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Solvent - Graphic Arts
40201116	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Printing: Flat Screen (Also See New Codes Under 4-02-040-XX)	2425000000	Solvent - Graphic Arts

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201121	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Steam Coil (Also See New Codes Under 4-02-040-XX)	2425000000	Solvent - Graphic Arts
40201122	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Fabric Print:Dryer: Fuel-fired (Also See New Codes Under 4-02-040- XX)	2425000000	Solvent - Graphic Arts
40201197	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Misc. Fugitives (Also New Codes 4-02-040-XX)	2425000000	Solvent - Graphic Arts
40201199	Chemical Evaporation	Surface Coating Operations	Fabric Coating/Printing	Other Not Classified (Also See New Codes Under 4-02-040-XX)	2425000000	Solvent - Graphic Arts
40201301	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Operation	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201303	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Mixing	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201304	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Storage	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201305	Chemical Evaporation	Surface Coating Operations	Paper Coating	Equipment Cleanup	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201310	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Knife Coater	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201320	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Reverse Roll Coater	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201330	Chemical Evaporation	Surface Coating Operations	Paper Coating	Coating Application: Rotogravure Printer	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201399	Chemical Evaporation	Surface Coating Operations	Paper Coating	Other Not Classified	2401030000	Solvent - Industrial Surface Coating & Solvent Use
40201401	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Coating Operation	2401060000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201402	Chemical Evaporation	Surface Coating Operations	Large Appliances	Cleaning/Pretreatment	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201403	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Mixing	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201404	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Storage	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201405	Chemical Evaporation	Surface Coating Operations	Large Appliances	Equipment Cleanup	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201406	Chemical Evaporation	Surface Coating Operations	Large Appliances	Topcoat Spray	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201410	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Coat Flashoff	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201411	Chemical Evaporation	Surface Coating Operations	Large Appliances	Topcoat Flashoff	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201431	Chemical Evaporation	Surface Coating Operations	Large Appliances	Coating Line: General	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201432	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Air Spray	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201433	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Electrostatic Spray	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201434	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Flow Coat	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201435	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Dip Coat	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201436	Chemical Evaporation	Surface Coating Operations	Large Appliances	Prime Electro-deposition	2401060000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201437	Chemical Evaporation	Surface Coating Operations	Large Appliances	Top Air Spray	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201438	Chemical Evaporation	Surface Coating Operations	Large Appliances	Top Electrostatic Spray	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201499	Chemical Evaporation	Surface Coating Operations	Large Appliances	Other Not Classified	2401060000	Solvent - Industrial Surface Coating & Solvent Use
40201501	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating/Application/Curing	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40201502	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Cleaning/Pretreatment	2415000000	Solvent - Degreasing
40201503	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Mixing	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40201504	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Storage	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40201505	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Equipment Cleanup	2415000000	Solvent - Degreasing
40201531	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Coating Line: General	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40201599	Chemical Evaporation	Surface Coating Operations	Magnet Wire Surface Coating	Other Not Classified	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40201601	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Application/Electrodeposition/Dip/Spray	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201602	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Cleaning/Pretreatment	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201603	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Coating Mixing	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201604	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Coating Storage	2401070000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201605	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Equipment Cleanup	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201606	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat Operation	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201607	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Sealers	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201608	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Deadeners	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201609	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Anti-corrosion Priming	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201619	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Surfacing Operation	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201620	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Repair Topcoat Application Area	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201621	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Automobiles	2401070000	Surface Coating: Motor Vehicles
40201622	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Automobiles	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201623	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Automobiles	2401070000	Surface Coating: Motor Vehicles
40201624	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Automobiles	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201625	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Automobiles	2401070000	Surface Coating: Motor Vehicles
40201626	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Automobiles	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201627	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Solvent-borne - Light Trucks	2401070000	Surface Coating: Motor Vehicles

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201628	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Prime Coating: Electro-deposition - Light Trucks	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201629	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Solvent-borne - Light Trucks	2401070000	Surface Coating: Motor Vehicles
40201630	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Guide Coating: Water-borne - Light Trucks	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201631	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Solvent-borne - Light Trucks	2401070000	Surface Coating: Motor Vehicles
40201632	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Topcoat: Water-borne - Light Trucks	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201699	Chemical Evaporation	Surface Coating Operations	Automobiles and Light Trucks	Other Not Classified	2401070000	Solvent - Industrial Surface Coating & Solvent Use
40201702	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Cleaning/Pretreatment	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201703	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Coating Mixing	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201704	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Coating Storage	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201705	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Equipment Cleanup	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201706	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Solvent Storage	2401040000	Surface Coating: Metal Cans
40201721	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two Piece Exterior Base Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201722	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Interior Spray Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201723	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Sheet Base Coating (Interior)	2401040000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201724	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Sheet Base Coating (Exterior)	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201725	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Side Seam Spray Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201726	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	End Sealing Compound (Also See 4-02-017-36 & - 37)	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201727	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Lithography	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201728	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Over Varnish	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201729	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Exterior End Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201731	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Sheet Base Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201732	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Sheet Lithographic Coating Line	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201733	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can-side Seam Spray Coating	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201734	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three-piece Can Interior Body Spray Coat	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201735	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two-piece Can Coating Line	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201736	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two-piece Can End Sealing Compound	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201737	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three Piece Can End Sealing Compound	2401040000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201738	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Two Piece Can Lithographic Coating Line	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201739	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Three Piece Can Coating Line (All Coating Solvent Emission Points)	2401040000	Surface Coating: Metal Cans
40201799	Chemical Evaporation	Surface Coating Operations	Metal Can Coating	Other Not Classified	2401040000	Solvent - Industrial Surface Coating & Solvent Use
40201801	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Prime Coating Application	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40201802	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Cleaning/Pretreatment	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40201803	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Mixing	2401055000	Surface Coating - Machinery and Equipment: SIC 37
40201804	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Solvent Storage (Use 4-07-004-01 thru 4-07-999-98 if possible)	2401055000	Surface Coating - Machinery and Equipment: SIC 38
40201805	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Equipment Cleanup	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40201806	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Finish Coating	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40201807	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Coating Storage	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40201899	Chemical Evaporation	Surface Coating Operations	Metal Coil Coating	Other Not Classified	2401055000	Solvent - Industrial Surface Coating & Solvent Use
40201901	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Operation	2401020000	Solvent - Industrial Surface Coating & Solvent Use
40201903	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Mixing	2401020000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40201904	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Coating Storage	2401020000	Solvent - Industrial Surface Coating & Solvent Use
40201999	Chemical Evaporation	Surface Coating Operations	Wood Furniture Surface Coating	Other Not Classified	2401020000	Solvent - Industrial Surface Coating & Solvent Use
40202001	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Operation	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202002	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Cleaning/Pretreatment	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202003	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Mixing	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202004	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Coating Storage	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202005	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Equipment Cleanup	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202010	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202011	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, High Solids	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202012	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Spray, Water-borne	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202013	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Dip	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202014	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flow Coat	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202015	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Prime Coat Application: Flashoff	2401025000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202020	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202021	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, High Solids	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202022	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Spray, Water-borne	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202023	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Dip	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202024	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flow Coat	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202025	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Topcoat Application: Flashoff	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202031	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Spray Line: General	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202032	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Dip Line: General (Use 4-02-020-37)	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202033	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray High Solids Coating (Use 4-02-020-35)	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202034	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Spray Water-borne Coating (Use 4-02-020-36)	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202035	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, High Solids	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202036	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Spray, Water-borne	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202037	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Dip	2401025000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202038	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flow Coat	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202039	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Single Coat Application: Flashoff	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202099	Chemical Evaporation	Surface Coating Operations	Metal Furniture Operations	Other Not Classified	2401025000	Solvent - Industrial Surface Coating & Solvent Use
40202101	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Base Coat	2401015000	Surface Coating: Wood Products Manufacturing
40202103	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Mixing	2401015000	Surface Coating: Wood Products Manufacturing
40202104	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Coating Storage	2401015000	Surface Coating: Wood Products Manufacturing
40202105	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Equipment Cleanup	2401015000	Surface Coating: Wood Products Manufacturing
40202106	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Topcoat	2401015000	Surface Coating: Wood Products Manufacturing
40202107	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler	2401015000	Surface Coating: Wood Products Manufacturing
40202108	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer	2401015000	Surface Coating: Wood Products Manufacturing
40202109	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Inks	2401015000	Surface Coating: Wood Products Manufacturing
40202110	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Grove Coat Application	2401015000	Surface Coating: Wood Products Manufacturing
40202111	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Stain Application	2401015000	Surface Coating: Wood Products Manufacturing
40202117	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Filler Sander	2401015000	Surface Coating: Wood Products Manufacturing
40202118	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Sealer Sander	2401015000	Surface Coating: Wood Products Manufacturing
40202131	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Water-borne Coating	2401015000	Surface Coating: Wood Products Manufacturing
40202132	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Solvent-borne Coating	2401015000	Surface Coating: Wood Products Manufacturing
40202133	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Ultraviolet Coating	2401015000	Surface Coating: Wood Products Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202140	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Surface Preparation (Includes Tempering, Sanding, Brushing, Grove Cut)	2401015000	Surface Coating: Wood Products Manufacturing
40202199	Chemical Evaporation	Surface Coating Operations	Flatwood: Wood Building Products	Other Not Elsewhere Classified	2401015000	Surface Coating: Wood Products Manufacturing
40202201	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Operation	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202202	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Cleaning/Pretreatment	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202203	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Mixing	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202204	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Coating Storage	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202205	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Equipment Cleanup	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202206	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Baseline Coating Mix	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202207	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne Coating	2401090000	Surface Coating: Misc. Manufacturing
40202208	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Medium Solids Solvent-borne Coating	2401090000	Surface Coating: Misc. Manufacturing
40202209	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Coating (25% Efficiency)	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202210	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: High Solids Solvent-borne Coating (40% Efficiency)	2401090000	Surface Coating: Misc. Manufacturing
40202211	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne Coating	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202212	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Low Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Surface Coating: Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202213	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Higher Solids Solvent-borne EMI/RFI Shielding Coating	2401090000	Surface Coating: Misc. Manufacturing
40202214	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Water-borne EMI/RFI Shielding Coating	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202215	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Business: Zinc Arc Spray	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202220	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202229	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Prime Coat Flashoff	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202230	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202239	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Color Coat Flashoff	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202240	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202249	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Topcoat/Texture Coat Flashoff	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202250	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202259	Chemical Evaporation	Surface Coating Operations	Plastic Parts	EMI/RFI Shielding Coat Flashoff	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202270	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Sanding/Grit Blasting Prior to EMI/RFI Shielding Coat Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202280	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Maskant Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202299	Chemical Evaporation	Surface Coating Operations	Plastic Parts	Other Not Classified	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202301	Chemical Evaporation	Surface Coating Operations	Large Ships	Prime Coating Operation	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202302	Chemical Evaporation	Surface Coating Operations	Large Ships	Cleaning/Pretreatment	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202303	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Mixing	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202304	Chemical Evaporation	Surface Coating Operations	Large Ships	Coating Storage	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202305	Chemical Evaporation	Surface Coating Operations	Large Ships	Equipment Cleanup	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202306	Chemical Evaporation	Surface Coating Operations	Large Ships	Topcoat Operation	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202399	Chemical Evaporation	Surface Coating Operations	Large Ships	Other Not Classified	2401080000	Solvent - Industrial Surface Coating & Solvent Use
40202401	Chemical Evaporation	Surface Coating Operations	Aerospace	Primer Application	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202402	Chemical Evaporation	Surface Coating Operations	Aerospace	Cleaning/Pretreatment	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202403	Chemical Evaporation	Surface Coating Operations	Aerospace	Coating Mixing	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202404	Chemical Evaporation	Surface Coating Operations	Aerospace	Coating Storage	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202405	Chemical Evaporation	Surface Coating Operations	Aerospace	Equipment Cleanup	2401075000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202406	Chemical Evaporation	Surface Coating Operations	Aerospace	Topcoat Application	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202499	Chemical Evaporation	Surface Coating Operations	Large Aircraft	Other Not Classified	2401075000	Solvent - Industrial Surface Coating & Solvent Use
40202501	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Operation	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202502	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Cleaning/Pretreatment	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202503	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Mixing	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202504	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Coating Storage	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202505	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Equipment Cleanup	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202510	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202511	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, High Solids	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202512	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Spray, Water-borne	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202515	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Prime Coat Application: Flashoff	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202520	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202521	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, High Solids	2401055000	Surface Coating - Machinery and Equipment: SIC 35

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202522	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Spray, Water-borne	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202523	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Dip	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202524	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flow Coat	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202525	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Topcoat Application: Flashoff	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202531	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Flow	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202532	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Dip	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202533	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Single Spray	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202534	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Flow and Spray	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202535	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Dip and Spray	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202536	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Conveyor Two Coat, Spray	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202537	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Manual Two Coat, Spray and Air Dry	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202542	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, High Solids	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202543	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Spray, Water-borne	2401055000	Surface Coating - Machinery and Equipment: SIC 35

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40202544	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Dip	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202545	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flow Coat	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202546	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Single Coat Application: Flashoff	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202599	Chemical Evaporation	Surface Coating Operations	Miscellaneous Metal Parts	Other Not Classified	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40202602	Chemical Evaporation	Surface Coating Operations	Steel Drums	Cleaning/Pretreatment	2415000000	Solvent - Degreasing
40202605	Chemical Evaporation	Surface Coating Operations	Steel Drums	Equipment Cleanup	2415000000	Solvent - Degreasing
40202701	Chemical Evaporation	Surface Coating Operations	Glass Mirrors	Mirror Backing: Coating Operation	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40202801	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Chemical Vapor Deposition of Preforms	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40202802	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Plasma Overcladding	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40202899	Chemical Evaporation	Surface Coating Operations	Glass Optical Fibers	Miscellaneous	2401065000	Solvent - Industrial Surface Coating & Solvent Use
40203001	Chemical Evaporation	Surface Coating Operations	Semiconductors	Solvent	2401065000	Surface Coating: Electronic and Other Electrical Coatings
40204001	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Print Paste	2425000000	Solvent - Graphic Arts
40204002	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Application	2425000000	Solvent - Graphic Arts
40204003	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Transfer	2425000000	Solvent - Graphic Arts
40204004	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Roller: Steam Cans/Drying	2425000000	Solvent - Graphic Arts

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204010	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Print Paste	2425000000	Solvent - Graphic Arts
40204011	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Application	2425000000	Solvent - Graphic Arts
40204012	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Transfer	2425000000	Solvent - Graphic Arts
40204013	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Rotary Screen: Drying/Curing	2425000000	Solvent - Graphic Arts
40204020	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Print Paste	2425000000	Solvent - Graphic Arts
40204021	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Application	2425000000	Solvent - Graphic Arts
40204022	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Transfer	2425000000	Solvent - Graphic Arts
40204023	Chemical Evaporation	Surface Coating Operations	Fabric Printing	Flat Screen: Drying/Curing	2425000000	Solvent - Graphic Arts
40204121	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204130	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204140	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Drying/Curing	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204150	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup	2415000000	Solvent - Degreasing
40204151	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204152	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204160	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204161	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204162	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Knife Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204221	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204230	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204240	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Drying/Curing	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204250	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup	2415000000	Solvent - Degreasing
40204251	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204252	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204260	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204261	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204262	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Roller Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204321	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204330	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204340	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Drying/Curing	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204350	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup	2415000000	Solvent - Degreasing
40204351	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204352	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204360	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204361	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204362	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Dip Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204421	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204430	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204431	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: First Roll Applicator	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204432	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Coating Application: Second Roll Applicator	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204435	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Lamination: Laminating Device	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204440	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204441	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: First Predrier	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204442	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Second Predrier	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204443	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Drying/Curing: Main Drying Tunnel	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204450	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cooler	2401090000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204455	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Winding	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204460	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup	2415000000	Solvent - Degreasing
40204461	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204462	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204470	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204471	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204472	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Transfer Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204521	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204530	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204531	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Extruder	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204532	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Coating Application: Coating Die	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204550	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cooling Cylinder	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204555	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Winding	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204560	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup	2415000000	Solvent - Degreasing
40204561	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204562	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204570	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204571	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204572	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Extrusion Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204621	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204630	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204631	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Calendar Rolls	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204632	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Coating Application: Pick Up Roll	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204650	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cooling Rolls	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204655	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Winding	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204660	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup	2415000000	Solvent - Degreasing
40204661	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204662	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204670	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204671	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40204672	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Melt Roll Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204721	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Mixing Tanks	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204730	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coating Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204735	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Coagulation Baths and Solvent Separation	2401090000	Surface Coating: Misc. Manufacturing
40204740	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Solvent Recovery	2401090000	Surface Coating: Misc. Manufacturing
40204750	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Drying	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204755	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Winding	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204760	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup	2415000000	Solvent - Degreasing
40204761	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Coating Application Equipment	2415000000	Solvent - Degreasing
40204762	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Cleanup: Empty Coating Drums	2415000000	Solvent - Degreasing
40204770	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40204771	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Cleaning Rags	2415000000	Solvent - Degreasing
40204772	Chemical Evaporation	Surface Coating Operations	Fabric Coating, Coagulation Coating	Waste: Waste Ink Disposal	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206010	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Preparation	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206030	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application	2401090000	Solvent - Industrial Surface Coating & Solvent Use

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40206031	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beam	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206032	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Beck	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206033	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jig	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206034	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Jet	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206035	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Dye Application: Continuous	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40206050	Chemical Evaporation	Surface Coating Operations	Fabric Dyeing	Waste	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40282001	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Area Drains	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40282002	Chemical Evaporation	Surface Coating Operations	Wastewater, Aggregate	Process Equipment Drains	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40282501	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Printing Blanket, Rotary Screen	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40282599	Chemical Evaporation	Surface Coating Operations	Wastewater, Points of Generation	Other Not Classified	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40288801	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	General	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40288821	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Basecoat	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40288822	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Coating	2401055000	Surface Coating - Machinery and Equipment: SIC 35

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
40288823	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Cleartop Coat	2401055000	Surface Coating - Machinery and Equipment: SIC 35
40288824	Chemical Evaporation	Surface Coating Operations	Fugitive Emissions	Clean-up	2415000000	Solvent - Degreasing
40299998	Chemical Evaporation	Surface Coating Operations	Miscellaneous	Miscellaneous	2401090000	Solvent - Industrial Surface Coating & Solvent Use
40500201	Chemical Evaporation	Printing/Publishing	Letterpress	Printing	2425000000	Solvent - Graphic Arts
40500204	Chemical Evaporation	Printing/Publishing	Letterpress	Dryer	2425000000	Solvent - Graphic Arts
40500205	Chemical Evaporation	Printing/Publishing	Letterpress	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40500301	Chemical Evaporation	Printing/Publishing	Flexographic	Printing	2425000000	Solvent - Graphic Arts
40500308	Chemical Evaporation	Printing/Publishing	Flexographic	Dryer	2425000000	Solvent - Graphic Arts
40500309	Chemical Evaporation	Printing/Publishing	Flexographic	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40500402	Chemical Evaporation	Printing/Publishing	Lithographic	Dryer	2425000000	Solvent - Graphic Arts
40500403	Chemical Evaporation	Printing/Publishing	Lithographic	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40500515	Chemical Evaporation	Printing/Publishing	Rotogravure	Dryer	2425000000	Solvent - Graphic Arts
40500516	Chemical Evaporation	Printing/Publishing	Rotogravure	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40500803	Chemical Evaporation	Printing/Publishing	Screen Printing	Dryer	2425000000	Solvent - Graphic Arts
40500804	Chemical Evaporation	Printing/Publishing	Screen Printing	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40500805	Chemical Evaporation	Printing/Publishing	Digital Printing	Dryer	2425000000	Solvent - Graphic Arts
40500806	Chemical Evaporation	Printing/Publishing	Digital Printing	Other non-dryer printing	2425000000	Solvent - Graphic Arts
40600259	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Marine Vessels	Tanker/Barge Cleaning	2415000000	Solvent - Degreasing
41000101	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Stoddard	2420000000	Dry Cleaning
41000115	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Washer/Extractor	2420000000	Dry Cleaning
41000125	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000126	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000130	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer	2420000000	Dry Cleaning
41000131	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000132	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Drying Cycle	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41000133	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000140	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration	2420000000	Dry Cleaning
41000141	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000142	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning
41000143	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000144	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000145	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000146	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000147	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning
41000160	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal	2420000000	Dry Cleaning
41000161	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000162	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000163	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning
41000164	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41000165	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000166	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Industrial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41000202	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Stoddard	2420000000	Dry Cleaning
41000215	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Washer/Extractor	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41000225	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Batch Flow	2420000000	Dry Cleaning
41000226	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Solvent Settling Tank: Continuous Flow	2420000000	Dry Cleaning
41000230	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer	2420000000	Dry Cleaning
41000231	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Loading/Unloading	2420000000	Dry Cleaning
41000232	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Drying Cycle	2420000000	Dry Cleaning
41000233	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Dryer: Cool Down Cycle	2420000000	Dry Cleaning
41000240	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration	2420000000	Dry Cleaning
41000241	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Single Charge	2420000000	Dry Cleaning
41000242	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Multiple Charge	2420000000	Dry Cleaning
41000243	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Diatomite: Regenerative	2420000000	Dry Cleaning
41000244	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Batch Operation	2420000000	Dry Cleaning
41000245	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Batch Operation	2420000000	Dry Cleaning
41000246	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, Carbon Core, Continuous Operation	2420000000	Dry Cleaning
41000247	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Filtration, Cartridge, All Carbon, Continuous Operation	2420000000	Dry Cleaning
41000260	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal	2420000000	Dry Cleaning
41000261	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Drained	2420000000	Dry Cleaning
41000262	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Filter Waste, Centrifuged	2420000000	Dry Cleaning
41000263	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Settling Tank Sludge	2420000000	Dry Cleaning

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
41000264	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Still Waste	2420000000	Dry Cleaning
41000265	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, All Carbon	2420000000	Dry Cleaning
41000266	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Commercial	Waste Disposal: Cartridge, Carbon Core Only	2420000000	Dry Cleaning
41080001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Equipment Leaks	Equipment Leaks	2420000000	Dry Cleaning
41082001	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Area Drains	2420000000	Dry Cleaning
41082002	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Aggregate	Process Equipment Drains	2420000000	Dry Cleaning
41082599	Chemical Evaporation	Dry Cleaning	Petroleum Solvent - Wastewater, Points of Generation	Other Not Classified	2420000000	Dry Cleaning
49000101	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Petroleum Naphtha (Stoddard)	2401090000	Surface Coating: Misc. Manufacturing
49000102	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Ethyl Ketone	2401090000	Surface Coating: Misc. Manufacturing
49000103	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Methyl Isobutyl Ketone	2401090000	Surface Coating: Misc. Manufacturing
49000104	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Furfural	2401090000	Surface Coating: Misc. Manufacturing
49000105	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Trichloroethylene	2401090000	Surface Coating: Misc. Manufacturing
49000199	Chemical Evaporation	Organic Solvent Evaporation	Solvent Extraction Process	Other Not Classified	2401090000	Surface Coating: Misc. Manufacturing
49000202	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Condenser Vent	2401090000	Surface Coating: Misc. Manufacturing
49000203	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Incinerator Stack	2401090000	Surface Coating: Misc. Manufacturing
49000206	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Fugitive Leaks	2401090000	Surface Coating: Misc. Manufacturing
49000207	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Distillation Vent	2401090000	Surface Coating: Misc. Manufacturing
49000208	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Decanting	2401090000	Surface Coating: Misc. Manufacturing
49000209	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Salting	2401090000	Surface Coating: Misc. Manufacturing

Point SCC	SCC Level One	SCC Level Two	SCC Level Three	SCC Level Four	Nonpoint SCC	Nonpoint Description
49000299	Chemical Evaporation	Organic Solvent Evaporation	Waste Solvent Recovery Operations	Other Not Classified	2401090000	Surface Coating: Misc. Manufacturing
49000301	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Ethylene Glycol	2415000000	Degreasing
49000302	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Chlorobenzene	2415000000	Degreasing
49000303	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	o-Dichlorobenzene	2415000000	Degreasing
49000304	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Creosote	2415000000	Degreasing
49000399	Chemical Evaporation	Organic Solvent Evaporation	Rail Car Cleaning	Other Not Classified	2415000000	Degreasing
49000401	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Acetone	2415000000	Degreasing
49000402	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Perchloroethylene	2415000000	Degreasing
49000403	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Methyl Methacrylate	2415000000	Degreasing
49000404	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Phenol	2415000000	Degreasing
49000405	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Propylene Glycol	2415000000	Degreasing
49000499	Chemical Evaporation	Organic Solvent Evaporation	Tank Truck Cleaning	Other Not Classified	2415000000	Degreasing
49000501	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Trichloroethylene	2401090000	Surface Coating: Misc. Manufacturing
49000502	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Perchloroethylene	2401090000	Surface Coating: Misc. Manufacturing
49000503	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	1,1,1-Trichloroethane	2401090000	Surface Coating: Misc. Manufacturing
49000504	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Chloroform	2401090000	Surface Coating: Misc. Manufacturing
49000599	Chemical Evaporation	Organic Solvent Evaporation	Air Stripping Tower	Solvent	2401090000	Surface Coating: Misc. Manufacturing
49000601	Chemical Evaporation	Organic Solvent Evaporation	Freon Recovery/Recycling Operations	CFC-12 Recovery - Auto Air Conditioning	2401090000	Surface Coating: Misc. Manufacturing
49099998	Chemical Evaporation	Organic Solvent Evaporation	Miscellaneous Volatile Organic Compound Evaporation	Miscellaneous	2401090000	Surface Coating: Misc. Manufacturing



## GASOLINE DISTRIBUTION: STAGE I

### A. Source Category Description

Stage I gasoline distribution includes the following gasoline emission points: 1) bulk terminals; 2) pipeline facilities; 3) bulk plants; 4) tank trucks; and 5) unloading at service stations. Emissions from Stage I gasoline distribution occur as gasoline vapors are released into the atmosphere. These Stage I processes are subject to EPA's maximum available control technology (MACT) standards for gasoline distribution.<sup>1</sup>

Emissions from gasoline distribution at bulk terminals and bulk plants take place when gasoline is loaded into a storage tank or tank truck, from working losses (for fixed roof tanks), and from working losses and roof seals (for floating roof tanks). Working losses consist of both breathing and emptying losses. Breathing losses are the expulsion of vapor from a tank vapor space that has expanded or contracted because of daily changes in temperature and barometric pressure; these emissions occur in the absence of any liquid level change in the tank. Emptying losses occur when the air that is drawn into the tank during liquid removal saturates with hydrocarbon vapor and expands, thus exceeding the fixed capacity of the vapor space and overflowing through the pressure vacuum valve.<sup>2</sup>

Emissions from tank trucks in transit occur when gasoline vapor evaporates from (1) loaded tank trucks during transportation of gasoline from bulk terminals/plants to service stations, and (2) empty tank trucks returning from service stations to bulk terminals/plants.<sup>3</sup> Pipeline emissions result from the valves and pumps found at pipeline pumping stations and from the valves, pumps, and storage tanks at pipeline breakout stations. Stage I gasoline distribution emissions also occur when gasoline vapors are displaced from storage tanks during unloading of gasoline from tank trucks at service stations (Gasoline Service Station Unloading) and from gasoline vapors evaporating from service station storage tanks and from the lines going to the pumps (Underground Storage Tank Breathing and Emptying). In 2014, Stage I Gasoline Distribution in the US, Puerto Rico, and US Virgin Islands resulted in more than 550,000 tons of VOC emissions.

For this source category, the following SCCs are assigned:

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2501050120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Terminals: All Evaporative Losses	Gasoline
2501055120	Storage and Transport	Petroleum and Petroleum Product Storage	Bulk Plants: All Evaporative Losses	Gasoline
2501060051	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Submerged Filling
2501060052	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Splash Filling
2501060053	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Stage 1: Balanced Submerged Filling
2501060201	Storage and Transport	Petroleum and Petroleum Product Storage	Gasoline Service Stations	Underground Tank: Breathing and Emptying

SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4
2505030120	Storage and Transport	Petroleum and Petroleum Product Transport	Truck	Gasoline
2505040120	Storage and Transport	Petroleum and Petroleum Product Transport	Pipeline	Gasoline

## B. Overview of Calculations

This section provides an overview of the calculations used to estimate VOC and HAP emissions from each source category. Data sources and calculations are discussed in section C. The process of allocating activity data to the county level is discussed in section D. Emissions factors are discussed in section E. The estimation of emissions from each source category is discussed in section G. The process of subtracting point source emissions from the total emissions estimates to determine nonpoint source emissions is discussed in section H.

### Bulk Terminals

The calculations for estimating VOC and HAP emissions from bulk terminals involve first multiplying the 1998 national VOC emissions developed in support of the Gasoline Distribution MACT standard by the ratio of the national volume of wholesale gasoline supplied between 1998 and 2017. Emissions from HAPs are calculated by multiplying VOC emissions by a national average speciation profile. National VOC and HAP emissions are allocated to states using data on refinery, bulk terminal, and natural gas plant stocks of motor gasoline in each state. State-level VOC and HAP emissions are then allocated to each county based on employment at petroleum bulk stations and terminals from the US Census County Business Patterns data for NAICS 42471 (Petroleum Bulk Stations and Terminals).

### Pipelines

The calculations for estimating VOC and HAP emissions from pipelines involve first multiplying the 1998 national VOC emissions developed in support of the Gasoline Distribution MACT standard by the 2017 to 1998 ratio of national volume of wholesale gasoline supplied. Emissions from HAPs are calculated by multiplying VOC emissions by a national average speciation profile. National VOC and HAP emissions are allocated to Petroleum Administration for Defense (PAD) District using data on the movement of finished motor gasoline in PAD District. PAD District-level VOC and HAP emissions are then allocated to each county based on employment at petroleum bulk stations and terminals from the US Census County Business Patterns data for NAICS 42471 (Petroleum Bulk Stations and Terminals).

### Bulk Plants

The calculations for estimating VOC and HAP emissions from bulk plants involve first calculating bulk plant gasoline throughput in the US based on data from the U.S. Energy Information Administration (EIA). National bulk plant gasoline throughput is then allocated to each county based on the number of petroleum bulk stations and terminals from the US Census County Business Patterns data for NAICS 42471. The number of petroleum bulk stations and terminals by county is multiplied by the emissions factor for VOC to estimate VOC emissions from bulk plants. County-level benzene speciation profiles are multiplied by VOC emissions to estimate benzene emissions from bulk plants. National average speciation profiles for all other HAPs are multiplied by VOC emissions to estimate HAP emissions from bulk plants.

### Tank Trucks in Transit

The calculations for estimating VOC and HAP emissions from tank trucks in transit involve first calculating county-level total gasoline consumption by summing onroad gasoline consumption and nonroad gasoline consumption in each county. County-level gasoline consumption is multiplied by the emissions factor for VOC to estimate VOC emissions from tank trucks in transit. County-level benzene speciation profiles are multiplied by VOC emissions to estimate benzene emissions from tank trucks in transit. National average speciation profiles for all other HAPs are

multiplied by VOC emissions to estimate HAP emissions from tank trucks in transit.

### **Underground Storage Tank (UST) Breathing and Storing**

The calculations for estimating VOC and HAP emissions from UST breathing and storing involve first calculating county-level gasoline consumption by summing onroad gasoline consumption and nonroad gasoline consumption in each county. County-level gasoline consumption is multiplied by the emissions factor for VOC to estimate VOC emissions from UST breathing and storing. County-level benzene speciation profiles are multiplied by VOC emissions to estimate benzene emissions from UST breathing and storing. National average speciation profiles for all other HAPs are multiplied by VOC emissions to estimate HAP emissions from UST breathing and storing.

### **Gasoline Service Station Unloading**

The calculations for estimating VOC and HAP emissions from gasoline service station unloading involve first calculating county-level total gasoline consumption by summing monthly onroad gasoline consumption and nonroad gasoline consumption in each county by fuel subtype. Monthly county-level gasoline consumption is then allocated to submerged, splash, and balanced filling technologies based on assumptions about the percentage of each filling technology used in each county. True vapor pressure is calculated for each county, month, and fuel subtype. Uncontrolled loading loss of liquid is calculated using true vapor pressure, temperature, molecular weight, and a saturation factor for the filling technology. Uncontrolled loading loss of liquid loaded is multiplied by monthly county-level gasoline consumption by fuel type to estimate VOC emissions from loading loss. Controlled VOC emissions are calculated by multiplying VOC emissions from loading loss by a control efficiency value. Controlled VOC emissions are subtracted from VOC emissions from loading loss to estimate monthly county-level VOC emissions by fuel subtype. Total county-level VOC emissions are calculated by summing monthly county-level VOC emissions by fuel subtype. County-level benzene speciation profiles are multiplied by VOC emissions to estimate benzene emissions from gasoline service station unloading. National average speciation profiles for all other HAPs are multiplied by VOC emissions to estimate HAP emissions from gasoline service station unloading.

## **C. Activity Data**

### **Bulk Terminals**

Emissions from bulk terminals are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. Therefore, there is no activity data for this source category. The emissions calculations are discussed in section G.

### **Pipelines**

Emissions from pipelines are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. Therefore, there is no activity data for this source category. The emissions calculations are discussed in section G.

### **Bulk Plants**

The activity data for estimating emissions from bulk plants are national volume of bulk plant gasoline throughput. The EIA's Petroleum Navigator reports the volume of finished motor gasoline supplied in the U.S.<sup>4</sup> The volume of finished motor gasoline is assumed to be the same as total gasoline consumption, and the volume of bulk plant gasoline throughput is assumed to be 9 percent of total gasoline consumption.<sup>5</sup>

$$GT_{US,bp} = V_{US} \times 0.09 \quad (1)$$

Where:

$$\begin{aligned} GT_{US,bp} &= \text{Bulk plant gasoline throughput in the U.S., in thousand barrels} \\ V_{US} &= \text{Volume of finished motor gasoline in the U.S., in thousand barrels} \end{aligned}$$

### **Tank Trucks in Transit**

The activity data for tank trucks in transit is county-level total gasoline consumption. County-level nonroad gasoline consumption is estimated by allocating MOVES derived state/SCC-level nonroad gasoline consumption to the county-level based on nonroad county/SCC-level CO<sub>2</sub> emissions.<sup>6</sup> County-level onroad consumption was estimated by subtracting the NMIM-derived national nonroad consumption from the EIA's estimate of finished motor gasoline

supplied and then allocating to counties using NMIM-derived onroad county-level CO<sub>2</sub> emissions.<sup>6</sup> County-level onroad consumption and county-level nonroad consumption are estimated by summing county-level monthly consumption estimates.

$$GC_{OR,c} = \sum GC_{OR,m} \quad (2)$$

Where:

$GC_{OR,c}$  = Onroad gasoline consumption in county  $c$ , in gallons  
 $GC_{OR,m}$  = Onroad gasoline consumption in county  $c$  for month  $m$ , in gallons

$$GC_{NR,c} = \sum GC_{NR,m} \quad (3)$$

Where:

$GC_{NR,c}$  = Nonroad gasoline consumption in county  $c$ , in gallons  
 $GC_{NR,m}$  = Nonroad gasoline consumption in county  $c$  for month  $m$ , in gallons

County-level tank truck gasoline throughput is estimated by summing county-level onroad and nonroad estimates, and multiplying the sum by 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station).<sup>5</sup>

$$GC_{c,t} = (GC_{OR,c} + GC_{NR,c}) \times 1.09 \quad (4)$$

Where:

$GC_{c,t}$  = Total gasoline consumption in county  $c$ , in gallons  
 $GC_{OR,c}$  = Onroad gasoline consumption in county  $c$ , in gallons  
 $GC_{NR,c}$  = Nonroad gasoline consumption in county  $c$ , in gallons

### Underground Storage Tank (UST) Breathing and Storing

The activity data for underground storage tank breathing and storing is county-level gasoline consumption, calculated as described above in the tank trucks in transit section.

### Gasoline Service Station Unloading

The activity data for gasoline service station unloading is county-level total gasoline consumption for each month and fuel subtype from MOVES.<sup>6</sup>

County-level gasoline consumption is estimated by summing onroad gasoline consumption and nonroad gasoline consumption and multiplying the sum by 1.09 to account for gasoline that is transported more than once in a given area (i.e., transported from bulk terminal to bulk plant and then from bulk plant to service station).<sup>5</sup>

$$GC_{c,t,m,f} = (GC_{c,OR,m,f} + GC_{c,NR,m,f}) \times 1.09 \quad (5)$$

Where:

$GC_{c,t,m,f}$  = Total gasoline consumption in county  $c$  for month  $m$  for fuel subtype  $f$ , in gallons  
 $GC_{c,OR,m,f}$  = Onroad gasoline consumption in county  $c$  for month  $m$  for fuel subtype  $f$ , in gallons  
 $GC_{c,NR,m,f}$  = Nonroad gasoline consumption in county  $c$  for month  $m$  for fuel subtype  $f$ , in gallons

The county-level gasoline consumption is allocated to submerged, splash, and balanced filling technologies. Percentages of each filling technology are derived from the EIIP study.<sup>14</sup> State, local, and tribal (SLT) agencies may submit input templates to update these default assumptions about the percentage of delivered fuel by filling

technology.

$$GC_{c,ft,m,f} = GC_{c,t,m,f} \times Perc_{ft,c} \quad (6)$$

Where:

$$\begin{aligned} GC_{c,ft,m,f} &= \text{Total gasoline consumption in county } c \text{ for filling technology } ft \text{ for month } m \text{ for fuel subtype } f, \\ &\quad \text{in gallons} \\ GC_{c,t,m,f} &= \text{Total gasoline consumption in county } c \text{ for month } m \text{ for fuel subtype } f, \text{ in gallons} \\ Perc_{ft,c} &= \text{Percentage of filling technology } ft \text{ in county } c \end{aligned}$$

## D. Allocation Procedure

### Bulk Terminals

Emissions from bulk terminals are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. The national-level emissions are allocated to the states based on the fraction of refinery, bulk terminal, and natural gas plant stocks in each state. The state-level emissions are distributed to the counties based on employment in NAICS 42471. These calculations are discussed in more detail in section G.

### Pipelines

Emissions from pipelines are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. The national-level emissions are allocated to the PAD Districts based on data on the movement of finished motor gasoline by pipeline between PAD Districts from the EIA. The emissions in each PAD District are distributed to the counties based on employment in NAICS 42471. These calculations are discussed in more detail in section G.

### Bulk Plants

The national volume of bulk plant gasoline throughput is allocated to counties using County Business Patterns employment data for NAICS code 42471 (Petroleum Bulk Stations and Terminals).<sup>7</sup> The number of petroleum bulk stations and terminals is first summed to the national level.

$$Emp_{US} = \sum Emp_c \quad (7)$$

Where:

$$\begin{aligned} Emp_{US} &= \text{Number of petroleum bulk stations and terminals in the U.S.} \\ Emp_c &= \text{Number of petroleum bulk stations and terminals in county } c \end{aligned}$$

The fraction of petroleum bulk stations and terminals by county is calculated by dividing the total number of petroleum bulk stations and terminals in a given county by the total number of petroleum bulk stations and terminals in the U.S.

$$EmpFrac_c = \frac{Emp_c}{Emp_{US}} \quad (8)$$

Where:

$$\begin{aligned} EmpFrac_c &= \text{Total fraction of petroleum bulk stations and terminals in county } c \\ Emp_c &= \text{Number of petroleum bulk stations and terminals in county } c \\ Emp_{US} &= \text{Number of petroleum bulk stations and terminals in the U.S.} \end{aligned}$$

The county-level volume of bulk plant gasoline throughput is calculated by multiplying the fraction of petroleum bulk stations and terminals in each county by the national volume of bulk plant gasoline throughput.

$$GT_{c,bp} = GT_{US,bp} \times EmpFrac_c \quad (9)$$

Where:

- $GT_{c,bp}$  = Bulk plant gasoline throughput in county  $c$ , in thousand barrels  
 $GT_{US,bp}$  = Bulk plant gasoline throughput in the U.S., in thousand barrels, from equation 1  
 $EmpFrac_c$  = Total fraction of petroleum bulk stations and terminals in county  $c$

Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one petroleum bulk station and terminal facility, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the following procedure is used for NAICS code 42471.

To gap-fill withheld state-level employment data:

- State-level data for states with known employment in NAICS 42471 are summed to the national level.
- The total sum of state-level known employment from step a is subtracted from the national total reported employment for NAICS 42471 in the national-level CBP to determine the employment total for the withheld states.
- Each of the withheld states is assigned the midpoint of the range code reported for that state. Table 1 lists the range codes and midpoints.
- The midpoints for the states with withheld data are summed to the national-level.
- An adjustment factor is created by dividing the number of withheld employees (calculated in step b of this section) by the sum of the midpoints (step d).
- For the states with withheld employment data, the midpoint of the range for that state (step c) is multiplied by the adjustment factor (step e) to calculate the adjusted state-level employment for landfills.

These same steps are then followed to fill in withheld data in the county-level business patterns.

- County-level data for counties with known employment are summed by state.
- County-level known employment is subtracted from the state total reported in state-level CBP (or, if the state-level data are withheld, from the state total estimated using the procedure discussed above).
- Each of the withheld counties is assigned the midpoint of the range code (Table 1).
- The midpoints for the counties with withheld data are summed to the state level.
- An adjustment factor is created by dividing the number of withheld employees (step h) by the sum of the midpoints (step j).
- For counties with withheld employment data, the midpoints (step i) are multiplied by the adjustment factor (step k) to calculate the adjusted county-level employment for landfills.

**Table 1. Ranges and midpoints for data withheld from state and county business patterns**

Employment Code	Ranges	Midpoint
A	0-19	10
B	20-99	60
C	100-249	175
E	250-499	375
F	500-999	750
G	1,000-2,499	1,750
H	2,500-4,999	3,750
I	5,000-9,999	7,500
J	10,000-24,999	17,500
K	25,000-49,999	37,500
L	50,000-99,999	75,000

Employment Code	Ranges	Midpoint
M	100,000+	

### **Tank Trucks in Transit**

The activity data for tank trucks in transit is available at the county-level; therefore county allocation is not needed.

### **Underground Storage Tank (UST) Breathing and Storing**

The activity data for UST breathing and storing is available at the county-level; therefore county allocation is not needed.

### **Gasoline Service Station Unloading**

The activity data for gasoline service station unloading is available at the county-level; therefore county allocation is not needed.

## **E. Emissions Factors**

### **Bulk Terminals**

Emissions from bulk terminals are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. Therefore there are no activity-based emissions factors for bulk terminals.

HAP emissions are estimated using speciation profiles shown in Table 2. Note that the values shown in Table 2 are percentages and should be divided by 100 before being multiplied by the VOC emissions.

**Table 2. HAP speciation factors for stage I gasoline distribution.**

HAP	Pollutant Code	Percentage of VOC Emissions	Reference
Benzene	71432	0.27	7
2,2,4-Trimethylpentane	540841	0.75	7
Cumene	98828	0.012	7
Ethyl Benzene	100414	0.053	7
n-Hexane	110543	1.8	7
Naphthalene	91203	0.00027	7
Toluene	108883	1.4	7
Xylenes	1330207	0.56	7

### **Pipelines**

Emissions from pipelines are calculated by growing the 1998 emissions estimates developed in support of the Gasoline MACT standard. Therefore there are no activity-based emissions factors for pipelines.

HAP emissions are estimated using speciation profiles shown in Table 2.

### **Bulk Plants**

The VOC emissions factor for bulk plants is 8.62 pounds of VOC per 1,000 gallons of gasoline.<sup>2</sup> HAP emissions are calculated using speciation profiles from Table 2, with the exception of benzene. Speciation profiles for benzene emissions from bulk plants are based on county-specific refueling emissions data from MOVES.<sup>8</sup>

### **Tank Trucks in Transit**

The VOC emissions factor for tank trucks in transit is 0.06 pounds of VOC per 1,000 gallons of gasoline. The VOC emission factor is the sum of the individual emission factors reported in the Gasoline Distribution EIIP guidance document for gasoline-filled trucks (traveling to service station/bulk plant for delivery) and vapor-filled trucks (traveling to bulk terminal/plant for reloading).<sup>3</sup>

**Table 3. Tank Trucks in Transit VOC Emission Factors**

	VOC Emission Factor	Reference
Vapor-Filled Trucks	0.055 lb/1,000 gallons	6
Gasoline Filled Trucks	0.005 lb/1,000 gallons	6
<b>Total</b>	<b>0.06 lb/1,000 gallons</b>	

HAP emissions are calculated using speciation profiles from Table 2, with the exception of benzene. Speciation profiles for benzene emissions from bulk plants are based on county-specific refueling emissions data from MOVES.

#### **Underground Storage Tank (UST) Breathing and Storing**

The VOC emissions factor for underground storage tank breathing and storing is 1 pound per 1,000 gallons. The VOC emissions factor for underground storage tank breathing and storing is recommended by the Gasoline Distribution EIIP guidance document.<sup>3</sup>

HAP emissions are calculated using speciation profiles from Table 2, with the exception of benzene. Speciation profiles for benzene emissions from bulk plants are based on county-specific refueling emissions data from MOVES.

#### **Gasoline Service Station Unloading**

To calculate the VOC emissions factor for gasoline service station unloading, first calculate the true vapor pressure for each county and month using the following equation and data from MOVES:<sup>6</sup> Geographic-specific information on the temperature of gasoline and the method of loading were obtained from a Stage I and II gasoline emission inventory study prepared for the EIIP.

The true vapor pressure is calculated using the following equation:

$$P_{c,m,f} = \left\{ \left[ 0.7553 - \left( \frac{413}{T_{c,m} + 459.6} \right) \right] S^{0.5} \log_{10}(RVP_{c,m,f}) - \left[ 1.854 - \left( \frac{1042}{T_{c,m} + 459.6} \right) \right] S^{0.5} + \left[ \left( \frac{2416}{T_{c,m} + 459.6} \right) - 2.013 \right] \log_{10}(RVP_{c,m,f}) - \left( \frac{8742}{T_{c,m} + 459.6} \right) + 15.64 \right\} \quad (10)$$

Where:

- $P_{c,m,f}$  = Stock true vapor pressure for county  $c$  in month  $m$  for fuel subtype  $f$ , in pounds per square inch absolute
- $T_{c,m}$  = Stock temperature for county  $c$  in month  $m$ , in degrees Fahrenheit
- $RVP_{c,m,f}$  = Reid vapor pressure for county  $c$  in month  $m$  for fuel subtype  $f$ , in pounds per square inch
- $S$  = Slope of the ASTM distillation curve at 10 percent evaporated, in degrees Fahrenheit per percent (assumed that  $S=3.0$  for gasoline per Figure 7.1-14a of AP-42)<sup>9</sup>

The following equation is used to calculate the VOC emissions factor for gasoline service station unloading:

$$L_{c,m,f} = 12.46 \times S_{ft} \times P_{c,m,f} \times M/T \quad (11)$$

Where:

$L_{c,mf}$	=	Uncontrolled loading loss of liquid loaded, in pounds per thousand gallons
$S_{ft}$	=	Saturation factor for filling technology ft
$P_{c,mf}$	=	True vapor pressure of liquid loaded, in pounds per square inch absolute
$M$	=	Molecular weight of vapors, in pounds per pound per mole
$T$	=	Temperature of liquid loaded (Rankine) <sup>14</sup>

HAP emissions are calculated using speciation profiles from Table 2, with the exception of benzene. Speciation profiles for benzene emissions from bulk plants are based on county-specific refueling emissions data from MOVES.

## F. Controls

There are county-level control efficiencies for service station unloading, including assumptions about the percentage of gasoline unloaded under different filling technologies: splash, submerged, or balanced. This is discussed in more detail in section G.

## G. Emissions

### Bulk Terminals

Emissions of VOCs for bulk terminals and pipelines are calculated by multiplying 1998 national emissions estimates developed in support of the Gasoline Distribution MACT standard (Table 4)<sup>2</sup> by the 2017 to 1998 ratio of the national volume of wholesale gasoline supplied.<sup>10, 11</sup> Emissions are converted from megagrams (Mg) to tons.

$$E_{VOC,US,bt} = E_{MACT,US,bt} \times \frac{G_{2017}}{G_{1998}} \times 1.1023 \text{ ton per Mg} \quad (12)$$

Where:

$E_{VOC,US,bt}$	=	Annual national-level emissions of VOC from bulk terminals, in tons
$E_{MACT,US,bt}$	=	1998 national VOC emission estimates developed for Gasoline Distribution MACT standard from bulk terminals, in Mg
$G_{2017}$	=	National volume of wholesale gasoline supplied in 2017, in thousand barrels per day
$G_{1998}$	=	National volume of wholesale gasoline supplied in 1998, in thousand barrels per day

**Table 4. 1998 Post-MACT Control Emissions**

Emission Point	1998 Post-MACT Control Emissions (Mg)	Reference
Pipelines	79,830	4
Bulk Terminals	137,555	4

National VOC emissions are allocated to states using the fraction of refinery, bulk terminal, and natural gas plant stocks of motor gasoline in each state (see Table 5).<sup>12</sup>

$$GasFrac_s = \frac{M_s}{M_{US}} \quad (13)$$

Where:

$GasFrac_s$	=	Fraction of motor gasoline in state $s$
$M_s$	=	Amount of motor gasoline in state $s$
$M_{US}$	=	Amount of motor gasoline in the U.S.

**Table 5. Refinery, Bulk Terminal, and Natural Gas Plant Stocks of Motor Gasoline, 2017**

State	Motor Gasoline (Thousand Barrels)	State	Motor Gasoline (Thousand Barrels)
Alabama	205	Montana	357
Alaska	793	Nebraska	92
Arizona	87	Nevada	146
Arkansas	175	New Hampshire	*
California	286	New Jersey	376
Colorado	190	New Mexico	108
Connecticut	*	New York	17
Delaware	*	North Carolina	200
District of Columbia	*	North Dakota	48
Florida	732	Ohio	970
Georgia	268	Oklahoma	348
Hawaii	1	Oregon	68
Idaho	276	Pennsylvania	25
Illinois	410	Rhode Island	*
Indiana	352	South Carolina	228
Iowa	183	South Dakota	77
Kansas	325	Tennessee	195
Kentucky	378	Texas	3,855
Louisiana	1,662	Utah	127
Maine	*	Vermont	30
Maryland	*	Virginia	150
Massachusetts	7	Washington	383
Michigan	266	West Virginia	36
Minnesota	363	Wisconsin	133
Mississippi	1,213	Wyoming	455
Missouri	202	<b>Total</b>	16,798

\* No Data Reported

The fraction of stocks of motor gasoline in each state is then used to distribute the VOC and HAP emissions.

$$E_{VOC,bt,s} = GasFrac_s \times E_{VOC,US,bt} \quad (14)$$

Where:

$$\begin{aligned} E_{VOC,bt,s} &= \text{Annual VOC emissions in state } s \text{ from bulk terminals, in tons} \\ GasFrac_s &= \text{Fraction of motor gasoline in state } s \\ E_{VOC,US,bt} &= \text{Annual national-level VOC emissions from bulk terminals, in tons} \end{aligned}$$

State-level VOC emissions are allocated to counties using the fraction of petroleum bulk stations and terminals facilities employees in each county from the US Census County Business patterns data for NAICS code 42471.<sup>7</sup>

$$EmpFrac_c = \frac{Emp_c}{Emp_s} \quad (15)$$

Where:

$$\begin{aligned} EmpFrac_c &= \text{Fraction of petroleum bulk stations and terminals facilities employees in county } c \\ Emp_c &= \text{Number of petroleum bulk stations and terminals facilities employees in county } c \\ Emp_s &= \text{Number of petroleum bulk stations and terminals facilities employees in state } s \end{aligned}$$

Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one petroleum bulk station and terminal facility, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the procedure discussed in Section D is used for NAICS code 42471.

The fraction of petroleum bulk stations and terminals facilities employees in each county is then used to distribute the VOC emissions.

$$E_{VOC,bt,c} = EmpFrac_c \times E_{VOC,bt,s} \quad (16)$$

Where:

$$\begin{aligned} E_{VOC,bt,c} &= \text{Annual VOC emissions from bulk terminals in county } c, \text{ in tons} \\ EmpFrac_c &= \text{Fraction of petroleum bulk stations and terminals facilities employees in county } c \\ E_{VOC,bt,s} &= \text{Annual VOC emissions from bulk terminals in state } s, \text{ in tons} \end{aligned}$$

Emissions of HAPs are calculated by multiplying emissions of VOCs by a national average speciation profile (Table 2).<sup>13</sup>

$$E_{p,c,bt} = E_{VOC,c,bt} \times S_p \quad (17)$$

Where:

$$\begin{aligned} E_{p,bt} &= \text{Annual emissions of pollutant } p \text{ in county } c \text{ from bulk terminal, in tons} \\ E_{VOC,bt} &= \text{Annual VOC emissions in county } c \text{ from bulk terminals, in tons} \\ S_p &= \text{Speciation profile of pollutant } p, \text{ as a fraction of VOC emissions} \end{aligned}$$

### Pipelines

Emissions of VOCs for pipelines are calculated by multiplying 1998 national estimates developed in support of the Gasoline Distribution MACT standard (Table 4)<sup>2</sup> by the 2017 to 1998 ratio of the national volume of wholesale gasoline supplied.<sup>10,11</sup> Emissions are converted to tons.

$$E_{VOC,US,pl} = E_{MACT,US,pl} \times \frac{G_{2017}}{G_{1998}} \times 1.1023 \text{ ton per Mg} \quad (18)$$

Where:

$$\begin{aligned} E_{VOC,US,pl} &= \text{Annual national-level emissions of VOC from pipelines, in tons} \\ E_{MACT,US,pl} &= \text{1998 national VOC emission estimates developed for Gasoline Distribution MACT standard from pipelines, in Mg} \\ G_{2017} &= \text{National volume of wholesale gasoline supplied in 2017, in thousand barrels per day} \\ G_{1998} &= \text{National volume of wholesale gasoline supplied in 1998, in thousand barrels per day} \end{aligned}$$

National VOC and HAP emissions are allocated to PAD Districts using the fraction of the total amount of finished motor gasoline that originated in each PAD District in 2017. There are five PAD Districts across the United States. PAD District 1 comprises seventeen states plus the District of Columbia along the Atlantic Coast; PAD District 2 comprises fifteen states in the Midwest; PAD District 3 comprises six states in South Central U.S.; PAD District 4 comprises five states in the Rocky Mountains; and PAD District 5 comprises seven states along the West Coast. These data, which are displayed below in Table 3, are reported in Table 35 of Volume 1 of Petroleum Supply Annual 2017.<sup>8</sup> States in each PAD District are shown in Table 4.

$$PADDFrac_{PD} = \frac{M_{PD}}{M_{US}} \quad (19)$$

Where:

$PADDfrac_{PD}$  = Fraction of motor gasoline in PAD District  $PD$   
 $M_{PD}$  = Amount of finished motor gasoline in PAD District  $PD$ , in thousand barrels  
 $M_{US}$  = Amount of finished motor gasoline in the U.S., in thousand barrels

$$E_{VOC,PD,pl} = PADDfrac_{PD} \times E_{VOC,US,pl} \quad (20)$$

Where:

$E_{VOC,PD,pl}$  = Annual VOC emissions from pipelines in PAD District  $PD$ , in tons  
 $PADDfrac_{PD}$  = Fraction of motor gasoline in PAD District  $PD$   
 $E_{VOC,US,pl}$  = Annual national-level VOC emissions of from pipelines, in tons

Pipeline emissions in each PAD District are allocated to counties based on County Business Patterns employment data. Because employment data for NAICS code 48691 (Pipeline Transportation of Refined Petroleum Products) are often withheld due to confidentiality reasons, the number of employees in NAICS code 42471 (Petroleum Bulk Stations and Terminals) are used for this allocation. To better account for the location of refined petroleum pipelines, however, no activity is allocated to States which had employees in this NAICS code, but did not have employees in NAICS code 48691 (i.e., District of Columbia, Idaho, Maine, New Hampshire, Vermont, and West Virginia). To allocate pipeline emissions in each PAD District to counties, first the county level employment data for NAICS code 42471 is summed to the PAD District.

$$Emp_{PD} = \sum Emp_c \quad (21)$$

Where:

$Emp_{PD}$  = Number of petroleum bulk stations and terminals facilities employees in PAD District  $PD$   
 $Emp_c$  = Number of petroleum bulk stations and terminals facilities employees in county  $c$

The fraction of petroleum bulk stations and terminals employees in each county is used to allocate the emissions from the PAD District to counties.

$$EmpFrac_c = \frac{Emp_c}{Emp_{PD}} \quad (22)$$

Where:

$EmpFrac_c$  = Fraction of petroleum bulk stations and terminals facilities employees in county  $c$   
 $Emp_c$  = Number of petroleum bulk stations and terminals facilities employees in county  $c$   
 $Emp_{PD}$  = Number of petroleum bulk stations and terminals facilities employees in PAD District  $PD$

Due to concerns with releasing confidential business information, the CBP does not release exact numbers for a given NAICS code if the data can be traced to an individual business. Instead, a series of range codes is used. Many counties and some smaller states have only one petroleum bulk station and terminal facility, leading to withheld data in the county and/or state business pattern data. To estimate employment in counties and states with withheld data, the procedure discussed in Section D is used for NAICS code 42471.

The fraction of petroleum bulk stations and terminals facilities employees in each county is then used to distribute the VOC emissions.

$$E_{VOC,c,pl} = EmpFrac_c \times E_{VOC,PD,pl} \quad (23)$$

Where:

$E_{VOC,c,pl}$  = Annual VOC emissions from pipelines in county  $c$ , in tons  
 $EmpFrac_c$  = Fraction of petroleum bulk stations and terminals facilities employees in county  $c$   
 $E_{VOC,PD,pl}$  = Annual VOC emissions from pipelines in PAD District  $PD$ , in tons

Emissions of HAPs are calculated by multiplying emissions of VOCs by a national average speciation profile.<sup>13</sup> Table 2 includes these speciation profiles. Total VOC emission estimates are used so emissions represent total emissions.

$$E_{p,c,pl} = E_{VOC,c,pl} \times S_p \quad (24)$$

Where:

$E_{p,c,pl}$  = Annual emissions of pollutant  $p$  from pipelines in county  $c$ , in tons  
 $E_{VOC,c,pl}$  = Annual VOC emissions from pipelines in county  $c$ , in tons  
 $S_p$  = Speciation profile of pollutant  $p$ , as a fraction of VOC emissions

**Table 6. Movement of Finished Motor Gasoline (thousand barrels) by Pipeline in PAD Districts, 2017**

PADD	Gasoline Moved (thousand barrels)	PADD Fraction
1	40,770	0.34
2	20,438	0.17
3	44,536	0.37
4	10,034	0.08
5	3,856	0.03

**Table 7. States by PAD District**

PAD District 1	PAD District 2	PAD District 3	PAD District 4	PAD District 5
Connecticut	Illinois	Alabama	Colorado	Alaska
Delaware	Indiana	Arkansas	Idaho	Arizona
Florida	Iowa	Louisiana	Montana	California
Georgia	Kansas	Mississippi	Utah	Hawaii
Maine	Kentucky	New Mexico	Wyoming	Nevada
Maryland	Michigan	Texas		Oregon
Massachusetts	Minnesota			Washington
New Hampshire	Missouri			
New Jersey	Nebraska			
New York	North Dakota			
North Carolina	Ohio			
Pennsylvania	Oklahoma			
Rhode Island	South Dakota			
South Carolina	Tennessee			
Vermont	Wisconsin			
Virginia				
West Virginia				

### Bulk Plants

VOC emissions from bulk plants are estimated by multiplying the VOC emission factor by county-level volume of bulk plant gasoline throughput.

$$E_{VOC,c,bp} = EF_{VOC,bp} / 1000 \text{ gallons} \times GT_{c,bp} \times 42 \text{ gallons per barrel} \quad (25)$$

Where:

$$\begin{aligned} E_{VOC,c,bp} &= \text{Annual emissions of VOC from bulk plants in county } c, \text{ in pounds} \\ EF_{VOC,bp} &= \text{Emissions factor for VOC from bulk plants, in pounds per 1,000 gallons} \\ GT_{c,bp} &= \text{Gasoline throughput for bulk plants in county } c, \text{ in thousand barrels} \end{aligned}$$

Benzene emissions are estimated by multiplying VOC emissions by county-level speciation profiles from MOVES.<sup>8</sup>

$$E_{BZ,c,bp} = E_{VOC,c,bp} \times S_{BZ,c} \quad (26)$$

Where:

$$\begin{aligned} E_{BZ,c,bp} &= \text{Annual emissions of benzene from bulk plants in county } c, \text{ in pounds} \\ E_{VOC,c,bp} &= \text{Annual emissions of VOC from bulk plants in county } c, \text{ in pounds} \\ S_{BZ,c} &= \text{Speciation profile for benzene for bulk plants in county } c, \text{ as a fraction of VOC} \end{aligned}$$

All other HAPs emissions are estimated by multiplying VOC emissions by the national average speciation profiles displayed in Table 2.

$$E_{p,c,bp} = E_{VOC,c,bp} \times S_{p,c} \quad (27)$$

Where:

$$\begin{aligned} E_{p,c,bp} &= \text{Annual emissions of pollutant } p \text{ from bulk plants in county } c, \text{ in pounds} \\ E_{VOC,c,bp} &= \text{Annual emissions of VOC from bulk plants in county } c, \text{ in pounds} \\ S_{p,c} &= \text{Speciation profile for pollutant } p \text{ for bulk plants in county } c, \text{ as a fraction of VOC} \end{aligned}$$

### Tank Trucks in Transit

VOC emissions from tank trucks in transit are calculated by multiplying county-level total gasoline consumption by the VOC emission factor for tank trucks in transit.

$$E_{VOC,c,tt} = EF_{VOC,tt} \times \frac{GC_{c,t}}{1000 \text{ gallons}} \quad (28)$$

Where:

$$\begin{aligned} E_{VOC,c,tt} &= \text{Annual emissions of VOC from tank trucks in transit in county } c, \text{ in pounds} \\ EF_{VOC,tt} &= \text{Emissions factor for VOC from tank trucks in transit, in pounds per 1,000 gallons} \\ GC_{c,t} &= \text{Gasoline consumption for tank trucks in transit in county } c, \text{ gallons} \end{aligned}$$

Benzene emissions are estimated by multiplying VOC emissions by county-level speciation profiles from MOVES.

$$E_{BZ,c,tt} = E_{VOC,c,tt} \times S_{BZ,c} \quad (29)$$

Where:

- $E_{BZ,c,tt}$  = Annual emissions of benzene from tank trucks in transit in county  $c$ , in pounds
- $E_{VOC,c,tt}$  = Annual emissions of VOC from tank trucks in transit in county  $c$ , in pounds
- $S_{BZ,c}$  = Speciation profile for benzene for tank trucks in transit in county  $c$ , as a fraction of VOC

All other HAPs emissions are estimated by multiplying VOC emissions by the national average speciation profiles in Table 2.

$$E_{p,c,tt} = E_{VOC,c,tt} \times S_{p,c} \quad (30)$$

Where:

- $E_{p,c,tt}$  = Annual emissions of pollutant  $p$  from tank trucks in transit in county  $c$ , in pounds
- $E_{VOC,c,tt}$  = Annual emissions of VOC from tank trucks in transit in county  $c$ , in pounds
- $S_{p,c}$  = Speciation profile for pollutant  $p$  for tank trucks in transit in county  $c$ , as a fraction of VOC

#### Underground Storage Tank (UST) Breathing and Storing

VOC emissions from UST breathing and storing are calculated by multiplying county-level total gasoline consumption by the VOC emission factor for UST breathing and storing.

$$E_{VOC,c,ust} = EF_{VOC,ust} \times \frac{GC_{c,t}}{1000 \text{ gallons}} \quad (31)$$

Where:

- $E_{VOC,c,ust}$  = Annual emissions of VOC from UST breathing and storing in county  $c$ , in pounds
- $EF_{VOC,ust}$  = Emissions factor for VOC from UST breathing and storing, in pounds per 1,000 gallons
- $GC_{c,t}$  = Gasoline consumption for UST breathing and storing in county  $c$ , in gallons

Benzene emissions are estimated by multiplying VOC emissions by county-level speciation profiles from MOVES.

$$E_{BZ,c,ust} = E_{VOC,c,ust} \times S_{BZ,c} \quad (32)$$

Where:

- $E_{BZ,c,ust}$  = Annual emissions of benzene from UST breathing and storing in county  $c$ , in pounds
- $E_{VOC,c,ust}$  = Annual emissions of VOC from UST breathing and storing in county  $c$ , in pounds
- $S_{BZ,c}$  = Speciation profile for benzene for UST breathing and storing in county  $c$ , as a fraction of VOC

All other HAPs emissions are estimated by multiplying VOC emissions by the national average speciation profiles displayed in Table 2.

$$E_{p,c,ust} = E_{VOC,c,ust} \times S_{p,c} \quad (33)$$

Where:

- $E_{p,c,ust}$  = Annual emissions of pollutant  $p$  from UST breathing and storing in county  $c$ , in pounds
- $E_{VOC,c,ust}$  = Annual emissions of VOC from UST breathing and storing in county  $c$ , in pounds
- $S_{p,c}$  = Speciation profile for pollutant  $p$  for UST breathing and storing in county  $c$ , as a fraction of VOC

### Gasoline Service Station Unloading

County-level uncontrolled loading loss of liquid loaded VOC emissions are calculated by multiplying the loading loss calculated in equation 8 by the total gasoline consumption in each county for each filling technology.

$$E_{VOC,c,m,f,ft,ll} = \frac{GC_{c,ft,m,f}}{1000 \text{ gallons}} \times L_{c,m,f} \quad (34)$$

Where:

- $E_{VOC,c,m,f,ft,ll}$  = VOC emissions from loading loss in county  $c$  for month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds
- $GC_{c,ft,m,f}$  = Total gasoline consumption in county  $c$  for month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in gallons
- $L_{c,m,f}$  = Uncontrolled loading loss of liquid loaded for county  $c$  for month  $m$  and fuel subtype  $f$ , in pounds per thousand gallons

County-level controlled VOC emissions are calculated by multiplying loading loss VOC emissions by a county-level control efficiency.<sup>14</sup> Emissions are divided by 100 to convert the control efficiency from a percentage.

$$E_{VOC,c,m,f,ft,ct} = E_{VOC,c,m,f,ft,ll} \times CE_c / 100 \quad (35)$$

Where:

- $E_{VOC,c,m,f,ft,ct}$  = Controlled VOC emissions in county  $c$  for month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds
- $E_{VOC,c,m,f,ft,ll}$  = VOC emissions from loading loss in county  $c$  month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds
- $CE_c$  = Control efficiency value for county  $c$ , as a percentage

County-level monthly VOC emissions by fuel subtype and filling technology are calculated by subtracting controlled VOC emissions from VOC emissions from loading loss.

$$E_{VOC,c,m,f,ft} = E_{VOC,c,m,f,ft,ll} - E_{VOC,c,m,f,ft,ct} \quad (36)$$

Where:

- $E_{VOC,c,m,f,ft}$  = VOC emissions in from gasoline service station unloading county  $c$  for month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds
- $E_{VOC,c,m,f,ft,ct}$  = Controlled VOC emissions in county  $c$  for month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds
- $E_{VOC,c,m,f,ft,ll}$  = VOC emissions from loading loss in county  $c$  month  $m$  for filling technology  $ft$  and fuel subtype  $f$ , in pounds

County-level total VOC emissions by filling technology are calculated by summing VOC emissions for each month and fuel subtype.

$$E_{VOC,c,ft} = \sum E_{VOC,c,m,f,ft} \quad (37)$$

Where:

- $E_{VOC,c,ft}$  = Annual VOC emissions in from filling type  $ft$  for gasoline service station unloading for county  $c$ , in pounds
- $E_{VOC,c,m,f,ft}$  = VOC emissions in from gasoline service station unloading county  $c$  for month  $m$  for filling

technology  $ft$  and fuel subtype  $f$ , in pounds

Benzene emissions are estimated by multiplying VOC emissions by county-level speciation profiles from MOVES.

$$E_{BZ,c,ssu} = E_{VOC,c,ssu} \times S_{BZ,c} \quad (38)$$

Where:

$$\begin{aligned} E_{BZ,c,ssu} &= \text{Annual emissions of benzene from gasoline service station unloading in county } c, \text{ in pounds} \\ E_{VOC,c,ssu} &= \text{Annual emissions of VOC from gasoline service station unloading in county } c, \text{ in pounds} \\ S_{BZ,c} &= \text{Speciation profile for benzene for gasoline service station unloading in county } c, \text{ as a fraction of VOC} \end{aligned}$$

All other HAPs emissions are estimated by multiplying VOC emissions by the national average speciation profiles displayed in Table 2.

$$E_{p,c,ust} = E_{VOC,c,ust} \times S_{p,c} \quad (39)$$

Where:

$$\begin{aligned} E_{p,c,ssu} &= \text{Annual emissions of pollutant } p \text{ from gasoline service station unloading in county } c, \text{ in pounds} \\ E_{VOC,c,ssu} &= \text{Annual emissions of VOC from gasoline service station unloading in county } c, \text{ in pounds} \\ S_{p,c} &= \text{Speciation profile for pollutant } p \text{ for gasoline service station unloading in county } c, \text{ as a fraction of VOC} \end{aligned}$$

## H. Point Source Subtraction

Some stage I gasoline emissions are reported in the point source inventory. To avoid double counting of emissions, point source emissions are subtracted from the total emissions from each source category to estimate the nonpoint emissions from each source category. Point source emissions are mapped to nonpoint source SCCs using the crosswalk shown in Table 14. The point source emissions table is also provided in an Excel input template. Point source emissions are submitted by SLT agencies.

$$NPE_{p,c,scc} = E_{p,c,scc} - PE_{p,c,scc} \quad (40)$$

Where:

$$\begin{aligned} NPE_{p,c,scc} &= \text{Annual nonpoint source emissions of pollutant } p \text{ from each SCC in county } c \\ E_{p,c,scc} &= \text{Annual total emissions of pollutant } p \text{ from each SCC in county } c \\ PE_{p,c,scc} &= \text{Annual total point source emissions of pollutant } p \text{ from each SCC in county } c \end{aligned}$$

## I. Sample Calculations

The tables below show sample calculations for estimating VOC and benzene emissions for stage I gasoline distribution. Each SCC relies on a speciation factor to estimate the benzene emissions from the VOC emissions. Note that bulk terminals and pipelines have a different benzene speciation factor than the other SCCs. The speciation factor for bulk terminals and pipelines is 0.0027. All other SCCs use a county-specific benzene speciation factor. See section E for more information.

### Bulk Terminals

**Table 8. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
12	$E_{VOC,US,bt}$ $= E_{MACT,US,bt} \times \frac{G_{2017}}{G_{1998}}$ $\times 1.1023 \text{ ton per Mg}$	$137555 \text{ Mg}$ $\times \frac{9327 \text{ thousand barrels per day}}{8253 \text{ thousand barrels per day}}$ $\times 1.1023 \text{ ton per Mg}$	171359 tons VOC emissions in the US
13	$GasFrac_s = \frac{M_s}{M_{US}}$	$\frac{205 \text{ thousand barrels}}{16798 \text{ thousand barrels}}$	.0052
14	$E_{VOC,bt,s} = GasFrac_s$ $\times E_{VOC,US,bt}$	.0052 × 171359 tons	891.1 tons VOC emissions in Arizona
15	$EmpFrac_c = \frac{Emp_c}{Emp_s}$	$\frac{6.54 \text{ employees}}{732 \text{ employees}}$	.0089
16	$E_{VOC,bt,c} = EmpFrac_c \times E_{VOC,bt,s}$	.0089 × 891.1 tons	7.93 tons VOC emissions in Apache County, AZ
17	$E_{p,c,bt} = E_{VOC,c,bt} \times S_p$	7.93 tons × 0.0027 speciation factor	.0214 tons benzene emissions in Apache County, AZ

### Pipelines

**Table 9. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
18	$E_{VOC,US,pl}$ $= E_{MACT,US,pl} \times \frac{G_{2017}}{G_{1998}}$ $\times 1.1023 \text{ ton per Mg}$	$137555 \text{ Mg}$ $\times \frac{9327 \text{ thousand barrels per day}}{8253 \text{ thousand barrels per day}}$ $\times 1.1023 \text{ ton per Mg}$	171359 tons VOC emissions in the US

Eq. #	Equation	Values for Apache County, AZ	Result
19	$PADDFrac_{PD} = \frac{M_{PD}}{M_{US}}$	$\frac{3,856 \text{ thousand barrels in PAD District 5}}{119,634 \text{ gasoline in US}}$	0.32
20	$E_{VOC,PD,pl} = PADDFrac_{PD} \times E_{VOC,US,pl}$	$0.32 \times 171359 \text{ tons}$	5,523 tons VOC emissions in PAD District 5
21	$Emp_{PD} = \sum Emp_c$	$\sum Emp_c$	10641 employees in PAD District 5
22	$EmpFrac_c = \frac{Emp_c}{Emp_{PD}}$	$\frac{6.54 \text{ employees}}{10641 \text{ employees}}$	.00061
23	$E_{VOC,c,pl} = EmpFrac_c \times E_{VOC,PD,pl}$	$.00061 \times 5,523 \text{ tons}$	3.37 tons VOC emissions in Apache County, AZ
24	$E_{p,c,pl} = E_{VOC,c,pl} \times S_p$	$3.37 \times 0.0027 \text{ speciation factor}$	0.9 tons benzene emissions in Apache County, AZ

## Bulk Plants

**Table 10. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
1	$GT_{US,bp} = V_{US} \times 0.09$	$3404186 \text{ thousand barrels} \times 0.09$	306377 thousand barrels
7	$Emp_{US} = \sum Emp_c$	$\sum Emp_c$	73908 employees in the US
8	$EmpFrac_c = \frac{Emp_c}{Emp_{US}}$	$\frac{6.54 \text{ employees}}{73908 \text{ employees}}$	.000089
9	$GT_c = GT_{US} \times EmpFrac_c$	$306377 \text{ thousand barrels} \times .000089$	27.11 thousand barrels in Apache County
25	$E_{VOC,c,bp} = \frac{EF_{VOC,bp}}{1000 \text{ gallon}} \times GT_{c,bp} \times 42 \text{ gallons per Mbbl}$	$8.62 \text{ pounds per 1,000 gallons} \div 1000 \text{ gallons} \times 27.11 \text{ thousand barrels} \times 42 \text{ gallons per Mbbl}$	9.8 pounds VOC emissions in Apache Count, AZ
26	$E_{BZ,c,bp} = E_{VOC,c,bp} \times S_{BZ,c}$	$9.8 \text{ pounds} \times 0.0061 \text{ speciation factor}$	.06 pounds benzene emissions in Apache County, AZ

## Tank Trucks in Transit

**Table 11. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
2	$GC_{OR,c} = \sum GC_{OR,m}$	$\sum GC_{OR,m}$	44,007,116.5 gallons of onroad gasoline consumed in Apache County, AZ
3	$GC_{NR,c} = \sum GC_{NR,m}$	$\sum GC_{NR,m}$	913,078.6 gallons of nonroad gasoline consumed in Apache County, AZ
4	$GC_{c,t} = (GC_{OR,c} + GC_{NR,c}) \times 1.09$	(44,007,116.5 gallons + 913,078.6 gallons) × 1.09	48,963,012.6 gallons of gasoline consumed in Apache County, AZ
28	$E_{VOC,c,tt} = (EF_{VOC,tt} \times GC_{c,t}) / 1000 \text{ gallons}$	(.06 pounds per 1000 gallons × 48,963,012.6 gallons) / 1000 gallons	2937.7 pounds VOC emissions in Apache County, AZ
29	$E_{BZ,c,tt} = E_{VOC,c,tt} \times S_{BZ,c}$	2937.7 pounds × 0.0061 speciation factor	17.9 pounds benzene emissions Apache County, AZ

## Underground Storage Tank (UST) Breathing and Storing

**Table 12. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
2	$GC_{OR,c} = \sum GC_{OR,m}$	$\sum GC_{OR,m}$	44,007,116.5 gallons of onroad gasoline consumed in Apache County, AZ
3	$GC_{NR,c} = \sum GC_{NR,m}$	$\sum GC_{NR,m}$	913,078.6 gallons of nonroad gasoline consumed in Apache County, AZ
4	$GC_{c,t} = (GC_{OR,c} + GC_{NR,c}) \times 1.09$	(44,007,116.5 gallons + 913,078.6 gallons) × 1.09	48,963,012.6 gallons of gasoline consumed in Apache County, AZ

Eq. #	Equation	Values for Apache County, AZ	Result
31	$E_{VOC,c,ust} = (EF_{VOC,ust} \times GC_{c,t}) / 1000 \text{ gallons}$	(1 pound per 1000 gallons × 48,963,012.62 gallons) /1000 gallons	48,963 pounds VOC emissions in Apache County, AZ
32	$E_{BZ,c,ust} = E_{VOC,c,ust} \times S_{BZ,c}$	48,963 pounds × 0.0061 speciation factor	298.7 pounds benzene emissions in Apache County, AZ

### Gasoline Service Station Unloading

These sample calculations use splash filling as an example, and the equations use fuel subtype 10 and January as an example. These calculations would need to be repeated using every month and both fuel subtypes to calculate values for each filling technology (splash, submerged, and balance).

**Table 13. Sample calculations for benzene emissions for Apache County, AZ in 2017 from Stage I Gasoline Distribution**

Eq. #	Equation	Values for Apache County, AZ	Result
5	$GC_{c,t,m,f} = (GC_{c,OR,m,f} + GC_{c,NR,m,f}) \times 1.09$	(1,650,266.8 gallons + 11,985.2 gallons) × 1.09	18,111,854.7 gallons
6	$GC_{c,ft,m,f} = GC_{c,t,m,f} \times Perc_{ft,c}$	18,111,854.7 gallons × 0 % splash filling	0 gallons splash filling in Apache County, AZ
10	$P_{c,m,f} = \left\{ \left[ 0.7553 - \left( \frac{413}{T_{c,m} + 459.6} \right) \right] S^{0.5} \log_{10}(RVP_{c,m,f}) - \left[ 1.854 - \left( \frac{1042}{T_{c,m} + 459.6} \right) \right] S^{0.5} + \left[ \left( \frac{2416}{T_{c,m} + 459.6} \right) - 2.013 \right] \log_{10}(RVP_{c,m,f}) - \left( \frac{8742}{T_{c,m} + 459.6} \right) + 15.64 \right\}$	$\left\{ \left[ 0.7553 - \left( \frac{413}{60 + 459.6} \right) \right] 3^{0.5} \log_{10}(10.61) - \left[ 1.854 - \left( \frac{1042}{60 + 459.6} \right) \right] 3^{0.5} + \left[ \left( \frac{2416}{60 + 459.6} \right) - 2.013 \right] \log_{10}(10.61) - \left( \frac{8742}{60 + 459.6} \right) + 15.64 \right\}$	5.54 pounds per square inch absolute
11	$L_{c,m,f} = 12.46 \times S_{ft} \times P_{c,m,f} \times M/T$	12.46 × 1.45 saturation factor × 5.54 pounds per square inch absolute × $\frac{65.5 \text{ pounds per pound per mole}}{520 \text{ Rankine}}$	12.61 pounds per 1000 gallons

Eq. #	Equation	Values for Apache County, AZ	Result
34	$E_{VOC,c,m,f,ft,ll} = \frac{GC_{c,ft,m,f}}{1000 \text{ gallons}} \times L_{c,m,f}$	$\frac{0 \text{ gallons splash filling}}{1000 \text{ gallons}} \times 12.61 \text{ pounds per 1000 gallons}$	0 pounds VOC emissions from uncontrolled loading loss in Apache County, AZ in January for fueling subtype 10 for splash filling
35	$E_{VOC,c,m,f,ft,ct} = E_{VOC,c,m,f,ft,ll} \times CE_c/100$	$0 \text{ pounds} \times 0 \text{ control efficiency}/100$	0 pounds controlled VOC emissions in Apache County, AZ in January for fueling subtype 10 for splash filling
36	$E_{VOC,c,m,f,ft} = E_{VOC,c,m,f,ft,ll} - E_{VOC,c,m,f,ft,ct}$	$0 \text{ pounds} - 0 \text{ pounds}$	0 pounds total VOC emissions in Apache County, AZ in January for fueling subtype 10 for splash filling
37	$E_{VOC,c,ft} = \sum E_{VOC,c,m,f,ft}$	$\sum E_{VOC,c,m,f,ft}$	0 pounds total VOC emissions in Apache County, AZ for splash filling
38	$E_{BZ,c,ft} = E_{VOC,c,ft} \times S_{BZ,c}$	$0 \text{ pounds} \times 0.0061 \text{ speciation factor}$	0 pounds benzene emissions in Apache County, AZ for splash filling

## **J. Changes from 2014 Methodology**

There are no significant changes from the methodology used to calculate the 2014 v2 NEI emissions.

## **K. Puerto Rico and U.S. Virgin Islands Emissions Calculations**

Since insufficient data exists to calculate emissions for the counties in Puerto Rico and the US Virgin Islands, emissions are based on two proxy counties in Florida: 12011, Broward County for Puerto Rico and 12087, Monroe County for the US Virgin Islands. The total emissions in pounds for these two Florida counties are divided by their respective populations creating a pound per capita emission factor. For each Puerto Rico and US Virgin Island county, the pound per capita emission factor is multiplied by the county population (from the same year as the inventory's activity data) which serves as the activity data. In these cases, the throughput (activity data) unit and the emissions denominator unit are "EACH".

## **L. Instructions for Submitting Point Activity Data to Input Template**

The Stage I Gasoline Distribution Input Template includes a template for submitting point source emissions data. The template includes all point SCCs that map to nonpoint Stage I Gasoline Distribution SCCs. These point source emissions should be submitted at the county level. The template does not include all combinations of county FIPS codes and point SCCs in order to limit the file size. Rather, the template contains a single row for each point SCC that maps to a nonpoint solvent SCC. To enter emissions for more than one county, copy the necessary rows to the bottom of the table. There is no need to copy rows for which you will not be submitting point source data. The 5-digit FIPS code must be entered for all counties for which point source emissions data is being submitted.

## M. References

- <sup>1</sup> U.S. Environmental Protection Agency, "National Emission Standards for Source Categories: Gasoline Distribution (Stage I), 40 CFR Part 63." Office of Air Quality Planning and Standards, February 28, 1997. Pages 9087-9093.
- <sup>2</sup> U.S. Environmental Protection Agency, "Gasoline Distribution Industry (Stage I) - Background Information for Proposed Standards," EPA-453/R94-002a, Office of Air Quality Planning and Standards, January 1994.
- <sup>3</sup> Eastern Research Group, Inc., "Volume III: Chapter 11, Gasoline Marketing (Stage I and Stage II), Revised Final," prepared for the Emission Inventory Improvement Program, January 2001.
- <sup>4</sup> U.S. Department of Energy, Energy Information Administration, Petroleum Navigator – Product Supplied, available from [https://www.eia.gov/dnav/pet/pet\\_cons\\_psup\\_dc\\_nus\\_mbbbl\\_a.htm](https://www.eia.gov/dnav/pet/pet_cons_psup_dc_nus_mbbbl_a.htm)
- <sup>5</sup> Cavalier, Julia, MACTEC, Inc., personal communication, "RE: Percentage of Gasoline Transported Twice By Truck," with Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, July 6, 2004.
- <sup>6</sup> 2008 NMIM runs performed by E.H. Pechan and Associates, Inc. for Laurel Driver, U.S. Environmental Protection Agency, Office of Transportation Air Quality. The NMIM model version was 20071009 with Mobile version M6203CHCM6203ChcOxFixNMIM.exe.
- <sup>7</sup> U.S. Department of Commerce, Bureau of the Census, County Business Patterns 2016, retrieved from <http://www.census.gov/econ/cbp/index.html>, released April 2018.
- <sup>8</sup> U.S. Department of Energy, Energy Information Administration, "Movements of Crude Oil and Petroleum Products by Pipeline Between PAD Districts, 2017," Table 37 in *Petroleum Supply Annual 2017, Volume 1* retrieved from <https://www.eia.gov/petroleum/supply/annual/volume1/>, released August 31, 2018
- <sup>9</sup> U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP 42, Fifth Edition, Volume I: Stationary Point and Area Sources, Chapter 7: Liquid Storage Tanks," Office of Air Quality Planning and Standards, Emission Inventory Group, September 1997.
- <sup>10</sup> U.S. Department of Energy, Energy Information Administration, "U.S. Daily Average Supply and Distribution of Crude Oil and Petroleum Products," Table 2 in *Petroleum Supply Annual 2017, Volume 1*, retrieved from <https://www.eia.gov/petroleum/supply/annual/volume1/>, released August 31, 2018
- <sup>11</sup> U.S. Department of Energy, Energy Information Administration, "U.S. Daily Average Supply and Distribution of Crude Oil and Petroleum Products," Table 2 in *Petroleum Supply Annual 1998, Volume 1*, retrieved from [https://www.eia.gov/petroleum/supply/annual/volume1/archive/1998/psa\\_volume1\\_1998.html](https://www.eia.gov/petroleum/supply/annual/volume1/archive/1998/psa_volume1_1998.html), released June 1999
- <sup>12</sup> U.S. Department of Energy, Energy Information Administration, "Refinery, Bulk Terminal, and Natural Gas Plant Stocks of Selected Petroleum Products by PAD District and State, 2017" Table 35 in *Petroleum Supply Annual 2017, Volume 1*, retrieved from <https://www.eia.gov/petroleum/supply/annual/volume1/>, released August 31, 2018
- <sup>13</sup> Hester, Charles, MACTEC, Inc. Memorandum from Charles Hester, MACTEC, Inc., to Stephen Shedd, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Standards Division, "Review of Data on HAP Content in Gasoline," May 18, 2006.
- <sup>14</sup> Pacific Environmental Services, Inc., "Draft Summary of the Analysis of the Emissions Reported in the 1999 NEI for Stage I and Stage II Operations at Gasoline Service Stations," prepared for the U.S. Environmental Protection Agency and the Emission Inventory Improvement Program, September 2002.

## APPENDIX

**Table 14. Point to nonpoint SCC crosswalk for stage I gasoline distribution.**

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40600501	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Leaks	2505040120	Storage and Transport; Pipeline; Gasoline
40600502	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pipeline Venting	2505040120	Storage and Transport; Pipeline; Gasoline
40600503	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station	2505040120	Storage and Transport; Pipeline; Gasoline
40600504	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Pipeline Petroleum Transport - General - All Products	Pump Station Leaks	2505040120	Storage and Transport; Pipeline; Gasoline
40400101	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400102	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400103	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400104	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Breathing Loss (250000 Bbl Capacity)- Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400105	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Breathing Loss (250000 Bbl Capacity)- Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400106	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Breathing Loss (250000 Bbl Capacity) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400107	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Working Loss (Diam. Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400108	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Working Loss (Diameter Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400109	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Working Loss (Diameter Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400110	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400111	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400112	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (67000 Bbl Capacity)- Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400113	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400114	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400115	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss (250000 Bbl Cap.) - Floating Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400116	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400117	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss (250000 Bbl Cap.) - Float Rf Tnk	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400118	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400119	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400120	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400121	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Diesel Fuel: Breathing Loss (Diameter Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400123	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Other Liquids: Breathing Loss (Diam Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400124	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Other Liquids: Working Loss (Diam Independent) - Fixed Roof Tank	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400131	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400132	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400133	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400141	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400142	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400143	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400148	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400150	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Miscellaneous Losses/Leaks: Loading Racks	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400151	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Valves, Flanges, and Pumps	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400152	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Collection Losses	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400153	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Vapor Control Unit Losses	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400161	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400162	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400163	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400171	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400172	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400173	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400178	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Gasoline RVP 13/10/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)	2501050120	Storage and Transport; Bulk Terminals; All Evaporative Losses: Gasoline
40400201	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400202	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Breathing Loss (67000 Bbl Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400203	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Breathing Loss (67000 Bbl. Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400204	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400205	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400206	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Working Loss (67000 Bbl. Capacity) - Fixed Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400207	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400208	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400209	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss (67000 Bbl Cap.) - Floating Roof Tank	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400210	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13/10/7: Withdrawal Loss (67000 Bbl Cap.) - Float Rf Tnk	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400211	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400212	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400213	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Filling Loss (10500 Bbl Cap.) - Variable Vapor Space	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400231	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400232	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400233	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - External Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400241	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400242	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400243	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Ext. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400248	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Ext. Float Roof (Pri/Sec Seal)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400250	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Loading Racks	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400251	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Valves, Flanges, and Pumps	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400252	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Collection Losses	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400253	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Miscellaneous Losses/Leaks: Vapor Control Unit Losses	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400261	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400262	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400263	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Internal Floating Roof w/ Primary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400271	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 13: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400272	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400273	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 7: Standing Loss - Int. Floating Roof w/ Secondary Seal	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400278	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Gasoline RVP 10/13/7: Withdrawal Loss - Int. Float Roof (Pri/Sec Seal)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400401	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Breathing Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400402	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 13: Working Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400403	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Breathing Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400404	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 10: Working Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400405	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Breathing Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40400406	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Petroleum Products - Underground Tanks	Gasoline RVP 7: Working Loss	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600101	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading **	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600126	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading **	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600131	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Normal Service)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600136	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Normal Service)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600141	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Balanced Service)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600144	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Splash Loading (Balanced Service)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline
40600147	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Submerged Loading (Clean Tanks)	2501055120	Storage and Transport; Bulk Plants; All Evaporative Losses: Gasoline

Point SCC	SCC Level 1	SCC Level 2	SCC Level 3	SCC Level 4	Nonpoint SCC	Nonpoint SCC Description
40400154	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Terminals	Tank Truck Vapor Leaks	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40400254	Chemical Evaporation	Petroleum Liquids Storage (non-Refinery)	Bulk Plants	Tank Truck Vapor Losses	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40600162	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Loaded with Fuel (Transit Losses)	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40600163	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Tank Cars and Trucks	Gasoline: Return with Vapor (Transit Losses)	2505030120	Storage and Transport; Tank Trucks in Transit, Gasoline
40600307	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Underground Tank Breathing and Emptying	2501060201	Storage and Transport; UST Breathing and Emptying; Gasoline
40600707	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Underground Tank Breathing and Emptying	2501060201	Storage and Transport; UST Breathing and Emptying; Gasoline
40600302	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Submerged Filling w/o Controls	2501060051	Service Station Unloading, Submerged
40600702	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Submerged Filling w/o Controls	2501060051	Service Station Unloading, Submerged
40600301	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Splash Filling	2501060052	Service Station Unloading, Splash
40600701	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Splash Filling	2501060052	Service Station Unloading, Splash
40600305	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Unloading **	2501060053	Service Station Unloading, Balanced
40600306	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Balanced Submerged Filling	2501060053	Service Station Unloading, Balanced
40600399	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Gasoline Retail Operations - Stage I	Other Not Elsewhere Classified	2501060053	Service Station Unloading, Balanced

<b>Point SCC</b>	<b>SCC Level 1</b>	<b>SCC Level 2</b>	<b>SCC Level 3</b>	<b>SCC Level 4</b>	<b>Nonpoint SCC</b>	<b>Nonpoint SCC Description</b>
40600706	Chemical Evaporation	Transportation and Marketing of Petroleum Products	Consumer (Corporate) Fleet Refueling - Stage I	Balanced Submerged Filling	2501060053	Service Station Unloading, Balanced

## **Appendix D**

### **2017 Point Source Inventory Documentation**



**Missouri Department of Natural Resources  
Division of Environmental Quality  
Air Pollution Control Program  
Jefferson City, Missouri**

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## **1.0 Introduction**

The Missouri Department of Natural Resources' Air Pollution Control Program (APCP) developed a statewide emissions inventory for 2017, as required by the EPA's Air Emissions Reporting Requirements (AERR) rule published December 17, 2008. Modifications were made to the AERR that were published February 6, 2014. These modifications included changes to the reporting threshold for lead (Pb). The 2014 inventory includes point, nonpoint, onroad mobile, and nonroad mobile source emissions. This document describes how the 2014 inventory is compiled and submitted to the National Emissions Inventory (NEI) through the EPA's Emission Inventory System (EIS). This report documents the 2014 inventory in detail, from its creation, quality assurance, and final summaries. It also details the qualifications and limitations of the inventory.

Various tables are included showing summarized, facility-specific, and source category-specific data. All emission amounts are given in tons per year unless otherwise noted. Blank fields and those with dashes indicate a value of zero. Fields with 0, 0.0, or 0.00 contain small values that round to zero.

## **2.0 Pollutants**

The 2014 inventory includes emissions of the traditional criteria air pollutants (CAPs) sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOC), coarse particulate matter (PM<sub>10</sub> Primary), fine particulate matter (PM<sub>2.5</sub> Primary), ammonia (NH<sub>3</sub>), and Pb. Missouri also inventories speciated Hazardous Air Pollutant (HAP) emissions for point sources. For some facilities, particulate matter (PM) is further disaggregated to its component parts: PM<sub>10</sub> Primary is the sum of PM condensable (PM CON) and PM<sub>10</sub> Filterable (PM<sub>10</sub> FIL), and PM<sub>2.5</sub> Primary is the sum of PM condensable (PM CON) and PM<sub>2.5</sub> Filterable (PM<sub>2.5</sub> FIL). Missouri's inventory does not include greenhouse gas (GHG) emissions and none of the tables in this document will summarize GHGs.

## **3.0 Geographic Coverage**

The 2014 emissions inventory covers the entire state of Missouri. Point source emissions are prepared at the facility level with a geographic coordinate. Nonpoint, onroad mobile, and nonroad mobile are submitted at the county level. There are no tribal areas in Missouri, and all 115 counties and municipalities are included.

## **4.0 Temporal Coverage**

Annual emissions are developed for all sources. The emissions cover a continuous 12 month period from January 1 to December 31 of the reporting year. Ozone season day emissions are submitted only for sources in the 5-county St. Louis Ozone Nonattainment area (Franklin, Jefferson, St. Charles, and St.

Louis Counties and the City of St. Louis). These emission estimates detail the amount of emissions on a typical summer day during the peak ozone season from June 1 through August 31. Only the ozone precursor pollutants of NO<sub>x</sub>, VOC and CO are reported at this temporal scale.

## **5.0 Staff Resources**

The department's APCP Air Quality Analysis (AQA) Section, Data Management Unit prepared the 2017 point source emissions inventory. Local agencies in the Kansas City, St. Louis County, and Springfield areas did not participate in inventory collection or quality assurance, but they do assist with identification of point source facilities. The department's APCP Air Quality Planning (AQP) Section, State Implementation Plan (SIP) unit prepared the 2017 nonpoint and mobile source emissions inventory. The individuals making up the 2017 NEI preparation team and their responsibilities are listed below:

- Stacy Allen, SIP Unit: Nonpoint source development and data submission; mobile source development and data submission
- Jeanne Brown, Data Management Unit: Point source data entry, quality assurance, and data submission
- Erin Henry, Data Management Unit: Point source quality assurance
- Cliff Li, SIP Unit: Nonpoint source development and data submission; mobile source development and data submission
- Nathan O'Neil, Data Management Unit Chief: Oversight of point source development, quality assurance, and data submission
- Terry Stock, Data Management Unit: Point source quality assurance
- Liberty Sitzes, Data Management Unit: Point source quality assurance
- Brenda Wansing, Data Management Unit: Point source data entry and quality assurance
- Daronn Williams, Data Management Unit: Point source quality assurance; HAP quality assurance

## 6.0 Data Collection and Handling

### 6.1. *Point Sources*

Point source data is collected from permitted facilities in the form of a report called the Emissions Inventory Questionnaire (EIQ). The EIQ is a report detailing facility operational data and estimating the amount of air pollution emitted, and its collection is governed by Missouri Statute 10 CSR 10-6.110. The facility will either submit a detailed annual “full” report, with updated calendar year operations and emissions, or a “reduced” report, which represents that their last full report emissions are a reasonable estimate for the current year, within emission change and permit tolerances. These reports are certified by the facility, but are subject to review and revision based on quality assurance performed by the state, or notification by the facility of errors in the original submission.

The AERR requires submission of Type A and B point source facilities actual emissions for the 2017 reporting year. The AERR definition of Type A and B point source facilities depends on the pollutant-specific PTE and location within a designated nonattainment area. Since Missouri does not maintain records of facility total potential to emit, the permit type is used to determine Type A and B status. Missouri has one area designated as an ozone nonattainment area, so the Type B thresholds for SO<sub>x</sub>, VOC, NO<sub>x</sub>, CO, Pb, PM<sub>10</sub> and NH<sub>3</sub> are compared to permit thresholds. Per Missouri operating permit rule 10 CSR 10-6.065, Part 70 sources and Intermediate sources have uncontrolled PTE of at least one pollutant in excess of the AERR Type B thresholds. All Missouri sources with Part 70 operating permits are submitted as Type A sources. All Missouri sources with Intermediate operating permits are submitted as Type B sources. Sources with either permit type are required to complete the “full” emissions report, detailing their actual operations and emissions during the 2017 year. In 2014, two sources that had neither a Part 70 operating permit nor an Intermediate operating permit were included in the Point Sources submission as they had annual Pb emissions above 0.5 Tons, but there were no sites that meet these criteria for 2017. For all facilities submitted as Point Sources, emission units permitted at the facility via their construction or operating permit are included in the report, including both stack and fugitive emission releases.

A fully detailed emission report contains several elements, most of which originated and continue to exist on paper EIQ forms. The following list provides brief description of the forms available for use in completing an EIQ. In general, forms beginning with number one (1) provide general facility information, and forms beginning with a two (2) provide detailed annual emission calculations. More information on EIQ forms is available at

<http://www.dnr.mo.gov/env/apcp/moeis/emissionsreporting.htm>

Form Name	Form Description	Form Number
Form 1.0 General Plant Information	General plant information, plant-wide emissions totals, signature section certifying submitted information is accurate and complete.	780-1431
Form 1.1 Process Flow Diagram	Diagram identifying and linking all emission units, processes, air pollution control devices, and emission release points for a facility.	780-1619
Form 1.2 Summary of Emission Units and Related Processes	List of all emission units, associated processes, and unit operating status.	780-1620
Form 2.0 Emission Unit Information	Main emissions reporting form; separate Form 2.0 required for each significant process for which emissions are being reported.	780-1621
Form 2.0C Control Device Information	Control device information when there is a control device operative at an emission unit; separate Form 2.0C required for each control device.	780-1434
Form 2.0K Charcoal Kiln Information	Details the operations and characteristics of charcoal kilns.	780-1530
Form 2.0L Landfill Information	Form for reporting emissions from landfills.	780-1583
Form 2.0P Portable Equipment Information	Details the locations and operations for portable equipment operations including quarries, asphalt plants, and concrete batch plants.	780-1433
Form 2.0S Stack/Vent Information	Stack information for emission units where emissions from a process enter the ambient air through one or more stacks/vents.	780-1435
Form 2.0Z Ozone Season Information Form	Calculation of ozone season day emissions of VOC, NO <sub>x</sub> , or CO; required from facilities located in the St. Louis ozone nonattainment counties of St. Louis, St. Charles, Franklin and Jefferson Counties and St. Louis City.	780-1452
Form 2.1 Fuel Combustion Worksheet	Combustion equipment itemization including equipment design rate and fuel type.	780-1436
Form 2.2 Incinerator Worksheet	Information related to the incinerator, waste material(s) incinerated, and the annual waste material throughput.	780-1438

Form Name	Form Description	Form Number
Form 2.3 VOC Process Mass-Balance Worksheet	Calculates a VOC mass balance emission factor from one or more VOC-containing materials.	780-1440
Form 2.4 Volatile Organic Liquid Loading Worksheet	Calculates an emission factor for petroleum liquid loading into tank trucks, rail cars, and barges based on AP-42.	780-1625
Form 2.5L General Liquid Storage Tank Information	Information about storage tanks.	780-1444
Form 2.7 Haul Road Fugitive Emissions Worksheet	Calculates an emission factor for unpaved haul roads based on AP-42 formula.	780-1445
Form 2.8 Storage Pile Worksheet	Calculates emission factors for activity and wind erosion from storage piles based on AP-42 formulas.	780-1446
Form 2.9 Stack Test/Continuous Emission Monitoring Worksheet	Documentation for emission factors derived from stack tests or CEM devices.	780-1447
Form 2.T Hazardous Air Pollutant Worksheet	Speciates HAP chemicals emitted at the process level; separates individual HAPs from those included in VOC/PM emissions.	780-1448
Form 3.0 Emission Fee Calculation	Summary table showing emissions from all processes.	780-1509
Form 3.0CK Emission Fee Calculation for Charcoal Kilns	Summary table showing emissions from charcoal kiln operations.	780-1508
Dry Cleaner – Non-chlorinated and Petroleum Based Solvents	Emissions calculations for dry cleaners using non-chlorinated solvent and with combined dryer capacity of 84 pounds or more.	780-1954
Form 4.0 Financial Cost Estimate	Estimate the cost of complying with air pollution regulation.	780-1622

Though paper forms were the origination of emission reporting, Missouri now has an online emission reporting system called the Missouri Emission Inventory System, or MoEIS. The data elements on the hardcopy forms have an electronic counterpart in MoEIS, though several data elements which were calculated by the user and written on the form are now automatically populated by MoEIS. For the full emission reports submitted by an AERR Type A or B facility, the report can be submitted either on paper forms or via MoEIS. Both submittals require a signature page to certify that representative emissions have been reported, to the best knowledge of the facility representative.

All data elements for full emission reports are stored in the underlying MoEIS database. For reports that are submitted on paper forms, the data is entered to the MoEIS database by the APCP staff members within a few weeks of receipt. Both the number and type of reports submitted annually are monitored to ensure proper coverage of AERR-reportable point source facilities. Paper forms were due by April 1, 2018, and MoEIS submissions were due by May 1, 2018. Late reports from AERR point source facilities were collected through reminders, enforcement actions, or site visits.

EIQ solicitations for calendar year 2017 were mailed to facilities the last week of December 2017. A total of 2,190 EIQs were mailed statewide, of which 219 were submitted as no production, 733 were full EIQs, and 1,238 were submitted as reduced reporting forms. Of those full reports, 446 facility reports are for AERR Type A or B facilities included as point sources in Missouri's submittal to the NEI.

## **7.0 Point Source Inventory**

### *7.1 Quality Assurance Prioritization*

The Data Management Unit prioritizes review of facilities that produce the most emissions, specifically facilities with a Part 70 or Intermediate operating permit. While every data element collected helps to characterize the emission estimate, the fields most directly tied to the emissions calculation are given the highest priority. Additional priority was given to improving stack parameter data. While this data does not directly impact reported emissions, it is important to the emissions modeling process.

### *7.2 Quality Assurance Methods*

The Data Management Unit's general quality assurance (QA) procedures utilize many of the techniques outlined in the EPA's Emission Inventory Improvement Program (EIIP) Technical Report Series Volume 6: Quality Assurance Procedures. The unit groups these techniques into two basic categories: Bottom-Up QA procedures and Top-Down QA procedures. Top-Down Procedures analyze groups of emissions data that share a common trait and look for outliers, in keeping with the 'Reality Check' technique. Bottom-Up procedures evaluate individual EIQs that are believed to be erroneous due to data entry errors or inconsistencies brought up by a third party. The Air Quality Analysis unit's quality assurance efforts are driven by top-down techniques, with individual EIQ improvements due to referrals from other air program staff. This allows prioritization of potential errors found and maximizes the results achievable with the available staff resources. Correction of individual reports is done based on the results of the top-down and referral reviews.

The Data Management Unit reviewed a number of types of data elements. SCC's were reviewed for appropriateness for the type of process being reported. Changes in SCC's from previous emission year reports were also reviewed to make sure the change was accurate and that the factors were changed when needed.

Emission factors were reviewed in a number of ways. When the facility chooses AP-42 or WebFIRE as the source of emission factor, the factors were compared to the current EPA factors to ensure the correct factors are being used for the SCC. Recent stack tests were reviewed and compared to the emission factors being reported. When needed, the emission factor was updated to match the most recent stack test. When a facility chooses engineering calculation for the source of emission factor, large changes in emission factors from previous reports were reviewed for accuracy.

Control equipment and efficiencies were reviewed. The type of control equipment was compared to the process being reported for appropriateness. Unexpected control efficiencies were compared to permit documentation to verify accuracy.

Large emission changes from previous reports were reviewed at the facility and process level. In some cases the facility was contacted to confirm the change.

Hazardous air pollutants review by comparing emissions to the emissions reported in EPA's Toxic Release Inventory (TRI). Where large differences were found, the facility was contacted to provide an explanation for the difference and/or updated HAP emissions.

All facilities that reported above 0.1 Tons of Pb facility level emissions were reviewed. Emission factors and throughputs were all verified with permit documentation and additional facility documentation.

Stack parameters were reviewed. When the stack height was reported as 10 feet or less, the facility was contacted to confirm the stack height. Reported flow rate and stack diameter were used to calculate a velocity, and the calculated velocity was compared to the reported velocity. When the difference between calculated velocity and reported velocity was greater than 5%, the facility was contacted to verify the correct stack parameters.

Throughout the year, inspectors and permit writers will contact the Data Management Unit with potential issues with individual facilities emissions data. These issues are reviewed and when appropriate, staff will work with the facility to make needed updates to the emissions report.

### *7.3 Ozone Season Day Emissions*

Ozone season day emissions are submitted only for sources in the 5-county St. Louis Ozone Nonattainment area (Franklin, Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis). These emission estimates detail the amount of emissions on a typical summer day during the peak ozone season from June 1 through August 31. Only the ozone precursor pollutants of NO<sub>x</sub>, VOC and CO are reported at this temporal scale. Ozone season day emissions are calculated using the Form 2.0Z Ozone Season Information Form or the Ozone Season Worksheet in MoEIS. The Ozone Season Worksheet calculates these emissions automatically for each emission process, using summer activity percentage, already provided by the facility, to convert the annual throughput into a summer

throughput. The calculated emissions for June 1 to August 31 are converted from pounds to Tons and then divided by 92 to get the average ozone season day emissions.

#### *7.4 EPA Augmentation and Quality Assurance*

After the point source data had been submitted to the EIS, EPA began their data augmentation and quality assurance process. The PM data augmentation involved adding PM10-PRI and PM2.5-PRI when just PM10-FIL, PM2.5-FIL, and PM-CON were reported. The PM data augmentation also involved adding PM10-FIL, PM2.5-FIL, and when appropriate PM-CON when just PM10-PRI and PM2.5-PRI were reported. These changes were reviewed and while the additional pollutants were added to Missouri's emissions in the NEI, the data submitted by Missouri was not altered. State submitted HAP data was compared to the 2014 and 2017 TRI and compared to the 2014 NEI. The sites with large differences were identified by EPA and the comparisons provided to the State for review. Missouri contacted a number of sites as a result of this comparison, and three facilities provided updated data that Missouri submitted to the EIS. EPA also preformed HAP data augmentation using SCC based HAP emission factors, and when specific HAPs were not reported by the State, these emissions were added to the NEI. Missouri will review the HAP factors used in this process and when appropriate will apply this information to future emission reports.

#### *7.5 Statewide Point Source Emission Totals*

Table 1 below lists the total emissions statewide, in tons per year, after facility reporting and quality assurance corrections were completed. The emissions in Table 1 do not include any additions due to EPA data augmentation.

**Table 1 – Statewide Annual Point Source Emission Totals**

<b>Pollutant</b>	<b>EMISSIONS (TONS)</b>
<b>Lead</b>	3.43
<b>CO</b>	58,835.88
<b>NH3</b>	1,334.30
<b>NOX</b>	75,261.70
<b>PM10-FIL</b>	3,686.71
<b>PM10-PRI</b>	4,482.33
<b>PM25-FIL</b>	1,435.79
<b>PM25-PRI</b>	2,056.00

<b>PM-CON</b>	4,921.73
<b>SO2</b>	116,359.22
<b>VOC</b>	14,687.12
<b>HAP*</b>	3,817.90

\*The emissions listed for HAP are the total of all speciated HAPs reported by Missouri to the NEI

## 8.0 EIS Data Submission

A total of 446 facilities were required to be reported as point sources to the 2017 NEI according to the AERR. Facility information along with relevant emissions data was uploaded to the Emission Inventory System (EIS) Gateway. Several steps were taken to prepare MoEIS data for submission to the NEI. Key steps included:

- All active emission units for previously identified facilities were retrieved from MoEIS and matched to corresponding emission units in EPA's EIS. Attributes such as operating status and descriptions were changed in the EPA database as needed. Also, new units were added.
- All facilities with Part 70 or Intermediate Operating Permits during the 2017 emission year were identified. Also, facilities that had a Part 70 or Intermediate Operating Permit for only a portion of the year were found and added to the submission list.
- A table of Emission Release Points for the previously identified Emission Units was compiled, including all relevant stack data. Missing stack data was obtained by contacting facility representatives or reviewing issued permits.
- All active Emission Processes for the previously identified facilities were retrieved from MoEIS and matched to corresponding emission units in EPA's database. Attributes such as the SCC code were changed as needed. Also, new processes were added to the EIS.
- Control devices were analyzed and completed where data fields were missing. Additionally, a query was written to verify that all active control devices were connected to an emission unit, while others verify that controlled units are marked as such and that controlled emission factors are used when appropriate.
- The data was queried to ensure that emission factors are marked controlled or uncontrolled as appropriate.
- Both MoEIS and EPA's system allow a division of emissions between different release paths. However, MoEIS requires the sum total of emissions to equal 100% at the unit level, while the federal system requires a sum of 100% per emission process. An Access query is used to determine which units have multiple processes so that corrections can be made before submission.

- An Access query was developed to ensure that point source facilities in the 5-county St. Louis ozone nonattainment area are including typical ozone season day emissions for VOC, NO<sub>x</sub>, and CO on the Ozone Season worksheet as required.

Data was transferred in steps to lower the total number of errors during each step of the submittal process. Basic facility information was uploaded first, followed by:

- Emission Units – All active emission units in MoEIS were uploaded. Operating status was changed for formerly active units.
- Emission Release Points- All active emission release points were uploaded. Operating status was changed for formerly active units.
- Emission Processes- All active emission processes uploaded and any that were no longer reportable were given a “last reporting year” in the EIS gateway.
- Control Approach- All active controls along with control percentage and pollutants controlled were uploaded.
- Emissions- Criteria and HAP annual pollutant emissions were uploaded to the EIS gateway.
- Ozone emissions for facilities in the nonattainment area were uploaded.

After each submittal, accuracy was verified by downloading the inventory from the gateway and comparing it to the data in MoEIS.

The Missouri Air Conservation Commission **ADOPTS** the following action  
on this 26th day of August, 2021:

Missouri State Implementation Plan Revision – Marginal Nonattainment  
Area Plan for the Missouri Portion of the St. Louis Nonattainment Area  
Under the 2015 Ozone Standard

R. H. Ri, Chairman

Mark C. Roy, Vice Chairman

Sam J. Pen, Member

Ronald B. Bays, Member

Ken Rabble, Member

\_\_\_\_\_, Member

\_\_\_\_\_, Member

## Morgan, Cheri

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**From:** Missouri DNR <modnr@modnr.dmarc.public.govdelivery.com>  
**Sent:** Friday, April 23, 2021 2:26 PM  
**To:** Downs, Jerry; Bloomer, Susan; Gilmore, David; Maliro, Patricia; Hall, Stephen; Bybee, Darcy; Quinn, Brian; Wilbur, Emily; Morgan, Cheri; Holden, Tisha; Kremer, Karen; Payne, Stan; Fredrick, Miranda; Patterson, Connie; Arwe, Andrea; Moore, Kyra; Beydler, Van; Stevens, Jeffrey  
**Subject:** Courtesy Copy: Missouri Air Conservation Commission Public Hearing - May 27, 2021

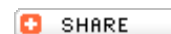
**This is a courtesy copy of an email bulletin sent by Cheri Morgan.**

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### **Missouri Air Conservation Commission Will Hold Public Hearing**

The Missouri Air Conservation Commission will hold a public hearing on Thursday, May 27, 2021 beginning at 9 a.m. Due to concerns regarding COVID-19, public participants of the meeting will be required to attend via Webex or telephone conference, listed on the Commission website, <https://dnr.mo.gov/env/apcp/macc.htm>.

The commission will hear testimony related to the following proposed actions:

- 10 CSR 10-6.376 (amendment) Cross-State Air Pollution Rule Annual SO2 Group 1 Trading Program

This rulemaking reverses the transfer of 1,300 SO2 emission allowances to a recently retired emission unit. The SO2 emission allowances will be reallocated to the original emission unit for which they were designated. In addition, this rulemaking clarifies rule language by condensing the list of provisions excluded from incorporation by reference.

- Missouri State Implementation Plan Revision – Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard

The purpose of this state implementation plan revision is to address the emissions inventory and other marginal ozone nonattainment area requirements pursuant to Clean Air Act Section 182(a) for the Missouri portion of the St. Louis nonattainment area under the 2015 ozone standard. The Missouri

portion of the St. Louis nonattainment area includes the City of St. Louis and the Counties of St. Louis and St. Charles, and Boles Township in Franklin County. EPA designated this area as a marginal nonattainment area under the 2015 ozone standard on June 4, 2018.

If the commission adopts the actions, it will be the department's intention to submit the actions to the U.S. Environmental Protection Agency to be included in Missouri's State Implementation Plan unless otherwise noted above.

Documents for the above items will be available for review at the Missouri Department of Natural Resources, Air Pollution Control Program, 1659 Elm Street, Jefferson City, (573) 751-4817 and in the Public Notices section of the program web site [www.dnr.mo.gov/env/apcp/public-notice.htm](http://www.dnr.mo.gov/env/apcp/public-notice.htm). This information will be available at least 30 days prior to the public hearing date.

The department will accept comments for the record until 5 p.m. on June 3, 2021. Please send written comments to Chief, Air Quality Planning Section, Air Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102-0176. Email comments may be submitted via the program web site noted above. All comments and public hearing testimony will be equally considered.

Citizens wishing to speak at the public hearing should notify the secretary to the Missouri Air Conservation Commission, Missouri Department of Natural Resources, Air Pollution Control Program, P.O. Box 176, Jefferson City, Missouri 65102-0176, or telephone (573) 751-7840. The department requests people intending to give verbal presentations also provide a written copy of their testimony to the commission secretary at the time of the public hearing.

People with disabilities requiring special services or accommodations to attend the meeting can make arrangements by calling the program directly at (573) 751-4817, the Division of Environmental Quality's toll free number at (800) 361-4827, or by writing two weeks in advance of the meeting to: Missouri Department of Natural Resources, Air Conservation Commission Secretary, P.O. Box 176, Jefferson City, MO 65102. Hearing impaired people may contact the program through Relay Missouri, (800) 735-2966.\TTY.

We'd like your feedback on the service you received from the Missouri Department of Natural Resources. Please consider taking a few minutes to complete the department's Customer Satisfaction Survey at [surveymonkey.com/r/MoDNRsurvey](https://surveymonkey.com/r/MoDNRsurvey). Thank you.



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## State Plan Actions

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### On Public Notice

#### **Missouri State Implementation Plan Revision – Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard**

The purpose of this state implementation plan revision is to address the emissions inventory and other marginal ozone nonattainment area requirements pursuant to Clean Air Act Section 182(a) for the Missouri portion of the St. Louis nonattainment area under the 2015 ozone standard. The Missouri portion of the St. Louis nonattainment area includes the City of St. Louis and the Counties of St. Louis and St. Charles, and Boles Township in Franklin County. EPA designated this area as a marginal nonattainment area under the 2015 ozone standard on June 4, 2018.

In accordance with RSMo Section 640.090, the Department has prepared an implementation impact report to accompany this nonattainment area plan. A link to this report is listed below.

#### [Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard](#)

#### [Appendices A-C](#)

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#### [Implementation Impact Report](#)

### Proposed for Adoption

None at this time.



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## Contact Information

#### **Air Pollution Control Program**

P.O. Box 176  
Jefferson City, MO 65102  
800-361-4827  
573-751-4817

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# PUBLIC HEARING 5/27/2021

<p style="text-align: right;">Page 9</p> <p>1 The Cross-State Air Pollution Rule, or</p> <p>2 CSAPR, is an emission-reduction program that aims to</p> <p>3 decrease the effects of air pollution from sources</p> <p>4 in upwind states on downwind states. CSAPR enables</p> <p>5 affected utilities to buy and sell emission</p> <p>6 allowances from other affected facilities in</p> <p>7 Missouri or other states.</p> <p>8 The Missouri Department of Natural</p> <p>9 Resources' Air Pollution Control Program is</p> <p>10 proposing to update emission allowances and make a</p> <p>11 minor clarification to paragraph (1)(B)(2). The</p> <p>12 primary purpose for this rule amendment is to return</p> <p>13 1,300 SO2 emission allowances to Iatan Unit 1 from</p> <p>14 the Asbury Power Plant.</p> <p>15 Iatan Unit 1 is owned by two electric</p> <p>16 utility companies: Evergy, formerly Kansas City</p> <p>17 Power and Light Company, and Liberty Utilities,</p> <p>18 which was formerly Empire District Electric. In</p> <p>19 2015, we revised the rule to reallocate 1,300 SO2</p> <p>20 emission allowances from Iatan Unit 1 to Asbury</p> <p>21 based on ownership share per a request from</p> <p>22 industry.</p> <p>23 Asbury retired in March, 2020, and</p> <p>24 Liberty Utilities and Evergy have requested to</p> <p>25 transfer the 1,300 credits back to Iatan Unit 1</p>	<p style="text-align: right;">Page 11</p> <p>1 this rule at this time.</p> <p>2 CHAIRMAN ROCHA: This is Commissioner</p> <p>3 Richard Rocha. Thank you, Shelly.</p> <p>4 Do any of the Commissioners have any</p> <p>5 comments or questions?</p> <p>6 Thank you. Hearing none.</p> <p>7 Secretary Gilmore, has anybody notified</p> <p>8 you requesting to speak?</p> <p>9 SECRETARY GILMORE: Chairman Rocha, I</p> <p>10 have not received any comments or requests to speak.</p> <p>11 CHAIRMAN ROCHA: Thank you.</p> <p>12 Is there anyone on the WebEx or telephone</p> <p>13 right now who wishes to speak?</p> <p>14 Okay. Hearing none. Thank you.</p> <p>15 The public hearing on the first item of</p> <p>16 this morning's meeting is now closed and we will</p> <p>17 move to the second item.</p> <p>18 Thank you, Shelly.</p> <p>19 So next up, we have Aaron Basham, who</p> <p>20 will present on the second public hearing item,</p> <p>21 Missouri State Implementation Plan Revision,</p> <p>22 Marginal Nonattainment Area Plan for the Missouri</p> <p>23 Portion of the St. Louis Nonattainment Area Under</p> <p>24 the 2015 Ozone Standard.</p> <p>25 Aaron.</p>
<p style="text-align: right;">Page 10</p> <p>1 before they are forfeited to the new-unit set-aside</p> <p>2 and redistributed to other emission units. This</p> <p>3 rulemaking would only reverse the 2015 reallocation</p> <p>4 of the 1,300 SO2 emission allowances. Asbury's</p> <p>5 remaining 3,180 allowances will transfer to new-unit</p> <p>6 set-aside for redistribution, as is the case for any</p> <p>7 unit that retires under the program.</p> <p>8 In accordance with the Code of Federal</p> <p>9 Regulations, the Department must submit a SIP</p> <p>10 revision to EPA by December 1 of the year before the</p> <p>11 year in which the Department sends the allowance</p> <p>12 allocations to EPA. Since Asbury did not operate in</p> <p>13 2020, the allowance allocation submission set to be</p> <p>14 made in June, 2022 will be the first submission</p> <p>15 where the 1,300 emission allowances would be</p> <p>16 forfeited if not reallocated. Therefore, the</p> <p>17 Department intends to submit this rule amendment to</p> <p>18 EPA by December 1, 2021.</p> <p>19 If the Commission adopts this rule</p> <p>20 action, the Department intends to submit this rule</p> <p>21 amendment to the U.S. Environmental Protection</p> <p>22 Agency to replace the current rule in the Missouri</p> <p>23 State Implementation Plan.</p> <p>24 Mr. Chairman, this concludes my</p> <p>25 testimony. I could answer any questions related to</p>	<p style="text-align: right;">Page 12</p> <p>1 MR. BASHAM: Thank you. If the court</p> <p>2 reporter would swear me in.</p> <p>3 AARON BASHAM,</p> <p>4 called as a witness, being first duly sworn,</p> <p>5 testified as follows:</p> <p>6 STATEMENT OF AARON BASHAM</p> <p>7 Mr. Chairman, members of the Commission,</p> <p>8 my name is Aaron Basham. I'm employed with Missouri</p> <p>9 Department of Natural Resources' Air Pollution</p> <p>10 Control Program. I work at 1659 East Elm Street in</p> <p>11 Jefferson City, Missouri.</p> <p>12 I am here today to present testimony on</p> <p>13 the proposed Missouri State Implementation Plan, or</p> <p>14 SIP Revision, titled Marginal Nonattainment Area</p> <p>15 Plan for the Missouri Portion of the St. Louis</p> <p>16 Nonattainment Area Under the 2015 Ozone Standard.</p> <p>17 The executive summary for the plan starts on page</p> <p>18 169 of the briefing document.</p> <p>19 On June 4, 2018, the U.S. Environmental</p> <p>20 Protection Agency designated the St. Louis area as</p> <p>21 non-attainment for the 2015 ozone standard of 70</p> <p>22 parts per billion.</p> <p>23 The Missouri portion of the</p> <p>24 non-attainment area includes St. Charles County, St.</p> <p>25 Louis County, St. Louis City, and Boles Township</p>

3 (Pages 9 to 12)

1 located in Franklin County. EPA classified the area  
2 as a marginal nonattainment area. The deadline for  
3 marginal nonattainment areas to attain the 2015  
4 ozone standard is August 3, 2021.

5 The purpose of this SIP revision is to  
6 fulfill the Federal Clean Air Act Section 182(a)  
7 requirements for the Missouri portion of the St.  
8 Louis marginal nonattainment area under the 2015  
9 ozone standard. Section 182(a) of the Clean Air Act  
10 specifically addresses the SIP requirements for  
11 ozone nonattainment areas classified as marginal.

12 Pursuant to Section 182(a)(1), the main  
13 element of this marginal plan is a comprehensive,  
14 accurate, current inventory of actual emissions from  
15 all sources in the area. Other elements from  
16 marginal areas which the state has already addressed  
17 through previous plan submissions and explained in  
18 this document include nonattainment new source  
19 review permitting requirements, emissions statement  
20 requirements, and the general offset requirement.

21 This plan addresses all required elements  
22 for marginal area plans, including comprehensive  
23 2017 base year emissions inventory for nitrogen  
24 oxides and volatile organic compounds in the area.

25 Since this is a nonattainment area SIP,

1 requests to speak or comment at all.  
2 CHAIRMAN ROCHA: Thank you.  
3 Is there anybody on the telephone or  
4 WebEx that wishes to speak on the record?  
5 Okay. Hearing none, the public hearing  
6 portion of today's meeting is hereby closed.  
7 (Public Hearing concluded at 10:29 a.m.)  
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1 the Air Program was required to develop an  
2 implementation impact report pursuant to the Revised  
3 Statutes of Missouri Section 640.090. The Air  
4 Program developed this report and shared with other  
5 state agencies listed in the statute and provided a  
6 copy of the proposed plan and report to the Governor  
7 and other elected officials listed in the statute.  
8 The report is currently available for viewing on the  
9 Department's website and will remain on the website  
10 for at least a year following the submission of the  
11 plan with the EPA.

12 If the Commission adopts this plan, the  
13 Department intends to submit it to U.S.  
14 Environmental Protection Agency for inclusion in the  
15 Missouri State Implementation Plan.

16 Mr. Chairman, Commissioners, that  
17 concludes my testimony. If there are any questions,  
18 I will be glad to answer them at this time.

19 CHAIRMAN ROCHA: This is Chairman Richard  
20 Rocha.

21 Do any of the Commissioners have any  
22 comments or questions for Aaron?

23 Secretary Gilmore, has anybody notified  
24 you requesting to speak?

25 SECRETARY GILMORE: I have received no

1 CERTIFICATE OF REPORTER  
2  
3  
4 I, JOYCE LAWRENCE, CSR# 84-1716, do  
5 hereby certify that the hearing was reported by  
6 me in stenotype and that the transcript is a  
7 true and correct transcription of my shorthand  
8 notes of said hearing.  
9  
10 I further certify that said hearing  
11 took place at the time and place hereinabove set  
12 forth and that the taking of said hearing was  
13 commenced and completed as hereinabove set out.  
14  
15 I further certify that I am not  
16 counsel for nor in any way related to any of the  
17 parties to this suit, nor am I in any way  
18 interested in the outcome thereof.

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Joyce D. Lawrence  
Certified Shorthand Reporter  
Registered Professional Reporter  
State of Illinois CSR License #84-1716

## **RECOMMENDATION FOR ADOPTION**

### **MISSOURI STATE IMPLEMENTATION PLAN REVISION –**

#### **MARGINAL NONATTAINMENT AREA PLAN FOR THE MISSOURI PORTION OF THE ST. LOUIS NONATTAINMENT AREA UNDER THE 2015 OZONE STANDARD**

On May 27, 2021, the Missouri Air Conservation Commission held a public hearing for the Missouri State Implementation Plan (SIP) revision titled – *Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard*. A summary of the comments received, and the Air Program’s corresponding responses is included on the following page(s). The Air Program revised the proposed plan as a result of comments received.

The Air Program has not reprinted the revised plan in the briefing document due to its volume. However, the Executive Summary is included for reference. The entire revised plan is available for review at the Missouri Department of Natural Resources’ Air Pollution Control Program, 1659 East Elm Street, Jefferson City, Missouri, 65101, (573)751-4817, [apcpsip@dnr.mo.gov](mailto:apcpsip@dnr.mo.gov).

The Air Program recommends the commission adopt the plan as revised. If the commission adopts this plan, the Air Program intends to submit it to the U.S. Environmental Protection Agency for inclusion in the Missouri State Implementation Plan.

## Executive Summary

The purpose of this document is to address the Clean Air Act requirements for the Missouri portion of the St. Louis nonattainment area under the 2015 ozone standard. The Missouri Department of Natural Resources' Air Pollution Control Program (air program) has prepared this state implementation plan (SIP) in accordance with the U.S. Environmental Protection Agency (EPA) SIP requirements rule for the 2015 ozone standard.<sup>1</sup> This plan addresses all required elements for marginal area plans, including a comprehensive base year emissions inventory for nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds (VOC) in the area.

The Missouri portion of the St. Louis nonattainment area includes St. Louis City, St. Charles and St. Louis counties, Boles Township in Franklin County, and additionally, on June 14, 2021 added Jefferson County (hereafter, referred to as the St. Louis nonattainment area).<sup>2</sup> The St. Louis nonattainment area is classified as a marginal ozone nonattainment area. Clean Air Act Section 182(a) includes the required SIP submissions for marginal ozone nonattainment areas. The main element addressed in this plan is the submission of a comprehensive, accurate, current inventory of actual emissions from all sources in the area.

Other Clean Air Act elements for marginal areas include nonattainment new source review (NNSR) permitting requirements, the emissions statement requirement, and the general offset requirement. The air program has already addressed these other elements through previous plan submissions. However, this document includes explanations of how the air program has addressed these other elements for the St. Louis nonattainment area.

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<sup>1</sup> 83 FR 62998, Federal Register Volume 83, Issue 234 (December 6, 2018)

<sup>2</sup> 86 FR 31438, Federal Register Volume 86, Issue 112 (June 14, 2021)



## COMMENTS AND RESPONSES ON

### MISSOURI STATE IMPLEMENTATION PLAN REVISION

#### **MARGINAL NONATTAINMENT AREA PLAN FOR THE MISSOURI PORTION OF THE ST. LOUIS NONATTAINMENT AREA UNDER THE 2015 OZONE STANDARD**

The public comment period for the *Marginal Nonattainment Area Plan for the Missouri Portion of the St. Louis Nonattainment Area Under the 2015 Ozone Standard* opened on April 26 and closed on June 3, 2021. Revisions to the proposed plan were made as a result of comments.

The following is a summary of comments received and the Missouri Department of Natural Resources' Air Pollution Control Program's (Air Program's) corresponding responses. Any changes to the proposed plan are included in the response to comments.

**SUMMARY OF COMMENTS:** During the public comment period for the proposed plan, the Air Program received three (3) comments from the U.S. Environmental Protection Agency (EPA).

**COMMENT #1:** EPA commented that due to re-examination of available 2018 data and information, Jefferson County, Missouri was designated as a nonattainment area for the 2015 Ozone National Ambient Air Quality Standards. EPA requested the Air Program to add the emissions inventories for Jefferson County to the plan.

**RESPONSE AND EXPLANATION OF CHANGE:** As a result of this comment, the Air Program updated the plan and appendices to reflect that Jefferson County was included in the nonattainment area. The emissions inventories in the plan and appendices now include Jefferson County.

**COMMENT #2:** EPA commented that the nonattainment area plan submittal is complete concerning the coverage of source categories, but the inventory documentation for point sources, as referred to in the plan, has been omitted. EPA requested the Air Program to update the appendices to add the time period, inventory collection methodologies, and quality assurance practices for the point sources.

**RESPONSE AND EXPLANATION OF CHANGE:** As a result of this comment, the Air Program added Appendix D to the plan with the information EPA requested in their comment.

**COMMENT #3:** EPA commented that the 2017 point source emissions inventory in Appendix B had fewer sources than were included in the 2011 inventory the Air Program submitted for the 2008 ozone standard. EPA requested the Air Program to provide a comparison table for these two point source inventories and explain the reason for any source listed in 2011 but not 2017.



**RESPONSE AND EXPLANATION OF CHANGE:** As a result of this comment, the Air Program revised Appendix B of the plan to provide a comparison table for the point source inventories in 2011 and 2017. The table provides an explanation for any source that was included in the 2011 inventory but not in the 2017 inventory.

Many of the differences between the two inventories are due to changes in the process that states used when submitting information activity data and throughput information for point sources for the National Emissions Inventory between the two inventory years. The new process enabled an improvement in determining industrial and commercial/institutional fuel combustion in the nonpoint data category, leading to more accurate nonpoint emissions. Due to the change in the procedures, many small sources previously in the point source category are now located in the nonpoint source category, reducing double counting issues.

Other common reasons for the differences are that the sources are no longer operating and because the 2011 inventory included all of Franklin County, but the 2017 inventory includes only sources located in Boles Township.